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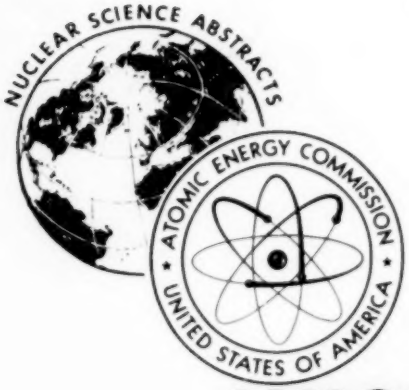

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NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

3983 (DOFL-TR-777) A STUDY OF ELECTRICAL PROPULSION OF ORDNANCE LAND VEHICLES. H. D. Cather (Diamond Ordnance Fuze Labs., Washington, D. C.). Sept. 30, 1960. 34p. (PB-171026)

The use of a fuel cell-electric motor combination as a propulsion system for future Ordnance land vehicles is investigated. The advantages of this type of system over the reciprocating internal-combustion engines are shown to include increased mobility, improved fuel logistics, decreased field maintenance, and greater tactical freedom. The vehicles for which this type of propulsion system is considered are in the 3- to 45-ton weight range, and carry payloads of $1\frac{1}{2}$ to 25 tons. Technological advances necessary before this system can be actually employed are discussed. (T.F.H.)

3984 (LAMS-2532(Vol.II)) MANHATTAN DISTRICT HISTORY, PROJECT Y, THE LOS ALAMOS PROJECT. VOLUME II. AUGUST 1945–DECEMBER 1946. Edith C. Truslow and Ralph Carlisle Smith (Los Alamos Scientific Lab., N. Mex.). 1946 and 1947. Contract W-7405-Eng-36. 247p.

A record is presented of the technical, administrative, and policy-making activities of the Los Alamos Project (Project Y) during the period following the end of World War II until the Manhattan District relinquished control to the Atomic Energy Commission as of January 1947. (auth)

3985 (NP-11148) REPORT ON THE ACTIVITIES OF THE DANISH ATOMIC ENERGY COMMISSION, APRIL 1, 1960–MARCH 31, 1961. (Denmark. Atomenergikommissionen, Copenhagen). Oct. 1961. 70p.

Activities of the Danish Atomic Energy Commission are summarized for the period of April 1960 to April 1961. The technical and administrative organization is outlined and a list of publications during the period is included. Topics discussed include work performed at the research establishment and international co-operation in the peaceful use of atomic energy. (C.H.)

3986 (SCTM-232-61-81) A METHOD FOR PREDICTING MAXIMUM TEMPERATURES IN WEAPONS DURING STORAGE. L. N. Dumas (Sandia Corp., Albuquerque, N. Mex.). Nov. 1961. Contract AT(29-1)-789. 22p.

An analytical method is presented for predicting the temperature-time response of a weapon in outdoor storage to environmental heat inputs. The effects of solar heating, convection, and radiation are included. The boundary conditions for desert storage are stipulated and compared with the recommendations of Climatic Extremes for Military Equipment (MIL STD 210A). (auth)

3987 (WT-1111) DRAG-FORCE MEASUREMENTS. M. Kornhauser and J. Petes (Naval Ordnance Lab., White Oak, Md.). June 13, 1958. Decl. July 11, 1961. 165p. Project 1.12 [of] Operation TEAPOT.

A three-component force gage suitable for measurement of transient aerodynamic drag loads on sting-mounted models was successfully developed and used on Shot 12 of Operation Teapot, using 3- and 10-inch-diameter spheres as models. Gages were positioned in three specially prepared areas: (1) a thermally absorbing, nondusty asphalt area; (2) a thermally reflecting, ideal water area; and (3) a thermally absorbing, dusty desert area. Comparison of peak forces at a 3-foot height over these surfaces indicated the highest forces in the dusty desert area, with lower forces in inconclusive order over the asphalt and water areas. These results compare favorably with the Ballistics Research Laboratory (BRL) drag-force measurements and vehicle-damage evaluation. Because of the presence of dust and other inhomogeneities in the air stream and because the gage readings depended on the uncertain properties of the pressure seal between model shell and sting, it was not considered valid to calculate field drag coefficients from the force and q data. Further, the extreme variability of the laboratory drag measurements indicated that many more field readings would be required for a significant comparison of field and laboratory results. Therefore, the only comparisons of drag coefficients were made between laboratory results and previously published drag coefficients of spheres at high Reynolds numbers and subsonic and transonic Mach numbers. Laboratory investigation revealed the high sensitivity of the sphere-sting configuration to angle of flow and, also, the difficulty of determining the actual angle of flow from the orthogonal force components. However, because the field forces recorded in the transverse and vertical directions were negligibly small and because dust scouring of the aluminum models was restricted to the front facing ground zero, it was concluded that on Shot 12 (at the 3-foot height) the air flow in the blast was parallel to the ground and directed radially outward from ground zero. The spherical force gages were tested in wind tunnel and shock tubes in the range of Mach numbers from 0.2 to 0.7, with Reynolds numbers from about 3×10^5 to 3×10^6 and shock overpressures from about 2 to 20 psi. Fair agreement is obtained between wind-tunnel and shock-tube drag coefficients, although the considerable scatter of the laboratory

results indicates the need for more extensive investigation. (auth)

3988 (WT-1125) FLEXIBLE MEASURING DEVICES AND INSPECTION OF OPERATION JANGLE STRUCTURES. C. O. Dohrenwend, L. D. Mills, J. S. Kinney, and E. E. Shalowitz (Bureau of Yards and Docks). July 28, 1958. Decl. July 11, 1961. 119p. Project 3.3.1 [of] Operation TEAPOT.

Tests were conducted to determine the effects of static structural flexibility, mass of loaded structural element, mass of the structure supporting the loaded structural element, and the length of the structure in the direction of pulse traveled on the normal loads generated against a structure by earth-propagated pulses resulting from underground explosions, and to inspect the damage to certain existing Operation Jangle structures and utilities within 1000 ft of ground zero. The records obtained from the experiment with 15 flexible measuring devices are considered accurate indications of their response to the pressures, accelerations, and strains occurring during the explosions. The close timewise agreement of initial accelerations, positive peaks, zero values, and negative peaks of the accelerometer records is an indication that the gage response to the impressed loads was characterized by freedom of action and similarity of manner. From the type of disturbances considered, only the structural flexibility and the length of the structure normal to the wave front, were indicative of having a significant effect on the magnitude on the generated loads. The conclusion reached from the experiments are outlined. (B.O.G.)

3989 (WT-1130) TEST OF CONCRETE PANELS. J. R. Allgood and W. A. Shaw (Bureau of Yards and Docks). Feb. 1957. Decl. Aug. 2, 1961. 81p. Project 3.8 of Operation TEAPOT.

Project 3.8 was planned to permit study of the behavior of reinforced concrete panels loaded into the plastic range as compared with the theoretically determined response. One each of ribbed and solid panels were tested as fixed end members at 3500 and 4850 feet from ground zero (GZ). Peak overpressures at these locations were approximately 6.5 and 4 psi, respectively. Limited damage was incurred; hence, the results did not permit optimum demonstration of the influence of the controlling parameters. Twenty channels of information including pressure, deflection, acceleration, and strain were obtained. The measurements permitted determination of quantities necessary to the accurate calculation of response. Justification for the relatively precise measurements and the accurate calculation of response is based upon the desirability of obtaining uniform blast resistance in all components of a given structure. Two ribbed panels and 14 one-foot wide beams representing typical sections of the solid panels were tested statically to supplement the blast test results. From these tests the resistance curve was determined and the formation and spread of the yield hinge was studied. Recorded behavior of the blast and static tests has been correlated with theory from which the following results and conclusions have been deduced: (1) the spring-mass-dashpot system provides a satisfactory analogy to the symmetrically restrained and loaded beam of uniform section; however, care must be exercised in the application of this analogy, since violation of any of the conditions of symmetry can invalidate the analogy; (2) it is possible to predict the rate-of-strain in the reinforcing steel with sufficient accuracy by combining the maximum velocity and strain relationships; (3) the percent fixity of a beam may be determined from steel strain measurements; (4) yielding occurs over a large portion of the beam even at relatively small plastic range deflections; and (5) a modification to the Bureau of Yards and Docks Method which accounts for damping provides better accuracy than the approach presently used. (auth)

3990 (FTD-TT-61-30) ATOMIC ENERGY (Selected Articles). Translated from Atomnaya Energ., 10: 565-633(1961). 158p.

Selected articles on atomic energy were translated from Atomnaya Energiya, Vol. 10, No. 6, 1961, pp. 565-633. Topics covered include partial fuel reloading in nuclear reactors; effect of irradiation on certain properties of graphite; neutron yield from reactions $Li^6(t,n)$ and $Li^7(t,n)$; effects of certain compounds on the oxidation of uranium in acids; investigation of the system $PuO_2F_2-HF-H_2O$; thermal strength in reactor engineering: coverings for structural elements in radioactive buildings; anisotropy of fission fragments of Pu^{240} and Pu^{239}; half-life of Cs^{137}; thermodynamic cycles of atomic power stations; influence of composition of uranium ores on the scintillation spectrum of their gamma radiation; determination of Ra, Th, and K in rocks from an airplane; use of a $CaSO_4-Sm$ phosphor in dosimetry; maximum possible concentrations of radioisotopes of inert gases from fission; and the separation of neon isotopes by thermal diffusion method. This translation was abstracted from the original language in NSA, Vol. 15, No. 21. (M.C.G.)

3991 (NP-tr-816) ATOMIC ENERGY (Selected Articles). Translated from Atomnaya Energ., 10: No. 4, 343-6; 372-3; 377-92; 396; 403-4; 406-7; 412-15; 420-2 (1961). 89p.

Seventeen articles are included on subjects such as thermionic cells, fission, reactor technology and theory, γ and neutron spectra, and the chemistry of rare metals and radioactive materials. (T.F.H.)

3992 THE EFFECTS OF A 100 MEGATON BOMB. Nigel Calder. New Scientist, 11: 644-5(Sept. 14, 1961).

The effects of a 100-megaton bomb were computed from those of a 10-megaton bomb by multiplying by the cube root of the ratio of the yields at the distances from the point of explosion for a given effect. Diagrams are given showing total destruction, main fire zone, moderate blast damage, serious fires, and light blast damage. (M.C.G.)

BIOLOGY AND MEDICINE

General and Miscellaneous

3993 (AERE-R-3811) THE USE OF IONISING RADIATION FOR THE ELIMINATION OF SALMONELLAE FROM FROZEN WHOLE EGG. A Study of the Feasibility of the Application of the Process in the United Kingdom. M. Ingram and D. N. Rhodes (Gt. Brit. Low Temperature Research Station. Radiation Group, Cambridge, England and F. J. Ley (United Kingdom Atomic Energy Authority. Isotope Research Div., Wantage, Berks, England). Aug. 1961. 33p. (LTRS-RM-365).

The nature and feasibility of a radiation treatment suitable for removing salmonellae from frozen egg is discussed. Heat-pasteurization, a process which is a promising alternative to irradiation, was also examined. The respective merits of heat and radiation pasteurization were compared. (M.C.G.)

3994 (HW-51938) ULTRASONIC METHODS OF DECONTAMINATING RATSKIN CONTAMINATED WITH YTTRIUM-91 AND PLUTONIUM-239. W. I. Neef and J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 20, 1957. Contract W-31-109-Eng-52. 6p.

Various reagents in combination with ultrasonic energy were used to attempt decontamination of ratskin and pigskin contaminated with yttrium or plutonium. Results indicate that ultrasonic decontamination methods are almost completely effective in removing yttrium and partially effective in removing plutonium. (auth)

3995 (NP-11020) QUARTERLY PROGRESS REPORT NO. 41 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Oct. 15, 1961. Contract AF41 (657)-252. 117p.

Nine reports, which are divided into groups of three, are included. The first group contains reports on the effects of ionizing radiations on the biochemistry of mammalian tissues; the second on pharmacological and toxicological compounds as protective or therapeutic agents against radiation injury in experimental animals; and the third on the influence of low level gamma and fast neutron irradiation exposures on the life span of animals. Each report is abstracted separately. (P.C.H.)

3996 (NP-11020(p.1-15)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. THE INFLUENCE OF REPEATED DOSES OF SULFUR-CONTAINING RADIOPROTECTIVE AGENTS ON INTERMEDIARY CARBOHYDRATE METABOLISM. Kenneth P. DuBois and Ann B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

A study was made on the cumulative toxic effects of dimethylammonium dimethyldithiocarbamate. Rats were given daily intraperitoneal doses of 200, 300, and 400 mgm/kgm for several days and groups of animals were sacrificed at 24 hours after various total doses of the compound. The rate of oxidation of pyruvate by the liver and kidney was measured. No appreciable cumulative effect on pyruvate oxidation by the kidney was observed but repeated doses of the compound produced progressively greater inhibitory effects on pyruvate oxidation by the liver. When animals were pretreated with 200, 300, or 400 mg/kg of the dithiocarbamate for several days and the severity of the immediate acute effects produced by a dose of 100 mg/kg was measured, it was found that the liver was rendered more sensitive to the acute dose by pretreatment for one or two days with 200 or 300 mg/kg of the compound. The susceptibility of the kidney was not affected by pretreatment with the compound. Measurements of the effects of treatment of rats with a combination of AET and MEA on pyruvic dehydrogenase activity of the liver and kidney were conducted. It was found that MEA does not increase the inhibitory effect of a daily dose of 200 mg/kg of AET on the enzyme activity of liver or kidney. The additive toxic effects of these two compounds, therefore, does not appear to be the result of combined effects on this enzyme system. (auth)

3997 (NP-11020(p.16-25)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. THE INFLUENCE OF ADRENAL DEMEDULLATION AND ERGOTAMINE ON THE RADIOPROTECTIVE ACTIVITY OF MERCAPTOETHYLAMINE. Bernard E. Hietbrink, Ann B. Raymund, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

The effect of MEA on the blood glucose levels of the rat was studied. The animals were given 200 mb/kg of MEA and blood samples were obtained after various intervals. A marked increase in blood glucose was evident at 30 minutes, reached a maximum after 2 to 3 hours and began to return toward normal after four hours. Measurements of the effect of ergotamine and adrenal demedullation on the radioprotective activity of MEA demonstrated that injection of ergotamine or removal of the adrenal medulla did not reduce the degree of protection provided the spleen, thymus glands, and small intestine by this compound. Thirty-day survival studies showed that removal of the adrenal medulla did not significantly affect the survival of animals exposed to 800 or 850 r of x irradiation or substantially alter the radioprotective activity of MEA administered before 1000 or 1200 r of x ray. Initial studies on the effect of oral administration of 600 mg/kg of MEA indicated that this treatment did not benefit the thymus glands but provided substantial protection to the spleen at 1, 2, and 3 hours after injection. Beneficial effects were observed in the intestine at two hours after rats were given MEA by this route. (auth)

3998 (NP-11020(p.26-37)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. THE EFFECT OF VARIOUS RADIOMIMETIC AGENTS, CYTOTOXIC AGENTS AND ANTIMETABOLITES ON THE ENZYME ACTIVITIES OF CERTAIN TISSUES OF RATS. Bernard E. Hietbrink and Ann B. Raymund (Chicago. Univ. Air Force Radiation Lab.).

The effects of triethylenemelamine on the adenosine triphosphatase activity of the spleen and thymus glands and on ghe cholinesterase activity of the small intestine were determined. Rats were given 0.75, 1.5, and 2.5 mg/kg of triethylenemelamine and sacrificed at various intervals. Marked changes in the enzyme activity of these tissues was observed after 1.5 and 2.5 mg/kg of this alkylating agent. Substantial changes in enzyme activity, which were maximal at about three days and returned toward normal after seven days, were caused by a sublethal dose of 1.5 mg/kg of triethylenemelamine. Measurements of the effect of several sulfur-containing compounds on the triethylenemelamine-induced changes in enzyme activity demonstrated that injection of radioprotective thiols before administration of triethylenemelamine increases the effect of this toxic agent

in the intestine. Administration of glutathione 15 minutes before and 2 and 4 hours after 15 mg/kg of chlorambucil reduced the damaging effects of this compound in the spleen and thymus glands, but the injection of cysteine increased the effects of chlorambucil in the hematopoietic tissues. Initial studies on the effect of ethionine on the enzyme activities of the spleen, thymus glands, and intestine indicate that doses as great as 500 mg/kg cause only a slight decrease in intestinal cholinesterase activity at three days after administration. (auth)

3999 (NP-11020(p.38-64)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Fifty-one chemical compounds were tested for evidence of radioprotective activity. Eight of these compounds exhibited moderate to marked radioprotective effects in that they permitted 30% or more of mice exposed to a lethal dose of whole-body x irradiation to survive for at least 30 days. Most of these agents also significantly prolonged the median survival time (ST_{50}) of the x-rayed animals. Twelve of the compounds tested resulted in a 30-day survival of 20% of the x rayed mice and nine of the compounds exhibited slight radioprotective activity in that they permitted the survival of only 10% of the irradiated mice. The most marked radioprotective effects were noted following the pre-irradiation administration of ethyl-N-(p-nitrobenzenesulfonyl) urethane (EL-158) (50% 30-day survival), benzyl-2,4-dichlorobenzylamine hydrochloride (EL-149) (40% 30-day survival) and bis-p-phenyl methane sulfone (EL-149) (40% 30-day survival). The five compounds which permitted 30% of the x-rayed mice to survive for 30 days after the radiation exposure were ethyl-n-(n-octylsulfonyl) carbamate (EL-175), m-trifluoromethylphenyl acetonitrile (EL-153), 2-methoxy-4-n-propyl phenol (EL-167), isonitrosopropiophenone (EL-152), and beta-hydroxyethyl ferrocine (EL-177). (auth)

4000 (NP-11020(p.65-77)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE COMPOUNDS. J. Doull, V. Plzak, and M. Root (Chicago. Univ. Air Force Radiation Lab.).

The ability of various radioprotective agents to reduce mortality at 30 days following single whole-body x-irradiation exposures was used to evaluate the comparative protection effect of these agents in male and female CF_1 mice. Using a log-probit transformation of the mortality data to compute the change in LD_{50} (30 days) it was found that the best protective effect was produced by the pre-irradiation administration of 2-aminoethyl isothiouranium (DRF = 1.69) and 5-hydroxytryptamine (DRF = 1.63) and that similar but less marked protective effects were produced by 2-aminopropyl isothiourea (DRF = 1.47), 2-mercaptoethylamine (DRF = 1.44), 1-acetyl-2-(2-aminoethyl) isothiourea (DRF = 1.39), and p-aminopropiophenone (DRF = 1.37). Least effective of the chemical radioprotective agents included in these studies were hydroxyacetonitrile (DRF = 1.18) and malononitrile (DRF = 1.12). Exposure to anoxic anoxia (produced by subjecting the animals to a simulated altitude of 20,000 feet) during radiation reduced the effective radiation dose by about 23% (DRF = 1.29). Since the regression lines obtained from the mortality data of the protected and control mice were linear and approximately parallel, it is apparent that all of these agents produce a true dose reduction throughout the range tested. (auth)

4001 (NP-11020(p.78-81)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. FURTHER STUDIES ON THE OXYGEN TENSION LEVELS IN SPLEEN AND THE RADIOPROTECTIVE ACTIVITY OF SODIUM NITRITE. A. T. Hasegawa and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

Doses of 150 and 200 mg/kg of sodium nitrite given intraperitoneally to mice decreased the oxygen tension in the spleen to 47 and 35% of normal, respectively. An intravenous injection of methylene blue (20 mg/kg) was used to prevent death from sodium nitrite thus permitting the administration of large doses of sodium nitrite. A high degree of protection against radiation lethality was obtained following 200 mg/kg of sodium nitrite when the radiation exposure was given at a time when the oxygen tension of the spleen was low. (auth)

4002 (NP-11020(p.82-95)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. EFFECTS OF PARTIAL BODY SHIELDING AND 2-MERCAPTOETHYLAMINE IN THE DRINKING WATER ON THE LIFE SPAN OF CHRONICALLY IRRADIATED MICE. A. Sandberg, V. J. Plzak, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

The influence of liver shielding on the lethal effects of chronic radiation exposure was investigated in CF_1 female mice given daily x-ray doses of 50, 100, and 200 r. Shielding of a part of the body corresponding to the approximate location of the liver resulted in only a slight reduction in the lethal effect of the exposure. The results suggest, however, that a more marked protective effect might be obtained with lower daily doses of radiation. Total-body shielding with the exception of the liver area increased the median survival time of chronically irradiated mice but the effect was less marked with the lowest radiation dosage level tested (50 r/day to death). Chronic exposure to whole-body x irradiation reduces the cytochrome oxidase activity of the liver of CF_1 female mice by about 30% and shielding of the liver area does not prevent this effect. It appears that this is an indirect effect in the liver produced by irradiation of some other organ system or tissue. The addition of 2-mercaptoethylamine to the drinking water of the mice at a concentration of 1 or 2 mg/ml did not prevent the lethal effects of chronic exposure to gamma irradiation at the rate of 88 r per day to death. Solutions of 2-mercaptoethylamine in distilled water retain their ability to protect CF_1 mice from the lethal effects of acute whole-body x-ray exposure for at least two weeks and even after several months, slight radioprotective activity can still be detected in such solutions. (auth)

4003 (NP-11020(p.96-104)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. STUDIES ON THE TOXICITY OF RARE EARTHS COMPOUNDS AND THEIR INFLUENCE ON RADIATION LETHALITY. David W. Bruce and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Studies on the mortality of female rats given a sublethal dose of thulium nitrate with 500 r of whole-body x irradiation showed a 73% increase in mortality as compared with either agent alone during a 30 day observation period. An

increase in the toxicity of erbium nitrate occurred when it was given simultaneously with 500 r of x ray as evidenced by an LD_{50} of 32 mg/kg of erbium for the animals given x ray as compared with a value of 81 mg/kg for the unirradiated controls. Approximate LD_{50} values of 2.4 and 13.0 mg/kg were obtained for praseodymium and erbium respectively when they were administered intravenously as the nitrate salts. Mortality occurred within the first four days after injection of praseodymium while deaths from erbium occurred throughout the 30 day observation period. The administration of repeated doses of praseodymium indicated that this metal is not cumulative in its toxic actions. Preliminary studies indicate that intravenously administered praseodymium nitrate decreases the endogenous respiration of liver slices and that radiation delays the recovery of the inhibitory effect on the respiration of the liver. (auth)

4004 (NP-11020(p.105-16)) INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. III. HISTOPATHOLOGICAL EFFECTS PRODUCED BY EUROPIUM NITRATE IN NORMAL AND X-IRRADIATED RATS. D. Vesselinovitch, Jone Meskauskas, David W. Bruce, and Frank W. Fitch (Chicago. Univ. Air Force Radiation Lab.).

Rats were given europium nitrate or nitric acid intraperitoneally with or without subsequent x irradiation. The animals were sacrificed either at 3 or 14 days after the treatment. Complete autopsies were performed on all animals and different tissues for histopathological study. The most important histopathological findings were fibrous and granulomatous inflammation of the peritoneum and peritoneal surfaces of the liver, spleen capsule, periadrenal tissue, fibroadipose tissue overlying the capsule of the kidney, and in the peritoneal adipose tissue. These changes were observed in the europium nitrate treated groups but not in animals treated with nitric acid. Animals treated with nitric acid had bloody ascitic fluid at 3 days but not at 14 days after treatment. Ascites persisted for 14 days in animals treated with europium nitrate alone or with x irradiation. In the europium nitrate treated groups the number of foreign-body giant cells, as well as the number of their nuclei, was smaller 3 days after treatment than at 14 days. The basophilic material stained positively and is suspected to consist partly of calcium. Histopathological changes such as atrophy of the lymphoid tissue in the spleen and hemorrhages in the sinusoids of the mesenteric lymph nodes were observed in animals treated with europium nitrate with and without x ray and in animals given only x irradiation but not in rats receiving nitric acid alone. The results of the study indicate that the toxicity of europium nitrate, as measured in terms of fibrous granulomatous peritonitis, does not depend upon the acidity of the rare earth. (auth)

4005 (NP-11113) DEVELOPMENT OF RADIATION PRESERVED HAM. Report No. 2 (Final), November 1, 1959–October 31, 1960. F. Warren Tauber (Visking Co., Chicago). Contract QMR&E (NATICK) No. 134. 12p.

A study was made of the effects of additions of nitrate, phosphate, dextrose or ascorbate to a pickling solution of salt and nitrite on the radiation preservation of 16- to 18-pound hams. The hams were irradiated at 3 and 4.5 Mrads, and evaluated for radiation effects on odor, color, flavor, and chemical and bacteriological changes at zero time and after storage for 3 months at room temperature. The results of the tests are tabulated. (B.O.G.)

4006 (NP-11115) USE OF VARIOUS AMOUNTS OF RADIATION AND HEAT PROCESSING IN THE PRESERVATION OF CANNED FOODS. Report No. 16 (Final), July 8, 1955 to December 31, 1960. E. F. Caldwell (Quaker Oats Co. Research Labs., Barrington, Ill.). Contract QMR&E (Natick) No. 15 (Agreement). 35p.

Studies were made to compare the effects of electron and gamma radiation for the preservation of oats and pancakes, and of various combinations of heat and irradiation for the preservation of chili. In connection with the study of chili, several dose distribution investigations were made to learn whether dose values as measured by glass dosimeters could be correlated with survival of bacteria distributed throughout various depths of the irradiated materials. (B.O.G.)

4007 (ORO-SP-174) RADIATION-PROCESSED FOODS AS A COMPONENT OF THE ARMED FORCES FEEDING SYSTEMS. John M. Barnes, Donald M. Boyd, George R. Fitzpatrick, Theodore S. Needels, Thomas A. O'Dowd, and Richard E. Tiller (Johns Hopkins Univ., Bethesda, Md. Operations Research Office). Aug. 1961. 100p.

The possible operational, logistical, and economic advantages to the armed forces of employing radiation-processed foods in the military feeding system were investigated. Radiation-sterilization technology, feeding concepts and operational requirements, food logistics, cost analysis, and provision of a mobilization base are discussed. (M.C.G.)

4008 (TID-13228) BIOLOGICAL, MEDICAL, AND ENVIRONMENTAL RESEARCH PROGRAM AS OF JANUARY 1961. (Division of Biology and Medicine, AEC). Apr. 1961. 52p.

The program of the Division of Biology and Medicine (DBM) is presented as directly as possible, including the reasons for the existence of the program, the basic assumptions which govern its conduct, its relationships with other programs, and the scope of its effort. The objectives of the program are given, and the three broad categories of research and individual programs are described. (P.C.H.)

4009 (UCSF-21) PROGRESS REPORT [ON BIOLOGY AND MEDICINE] FOR PERIOD ENDING SEPTEMBER 30, 1961. (California. Univ., San Francisco. School of Medicine. Radiological Lab.). Nov. 1961. Contract AT(11-1)-GEN-10. 107p.

The results obtained by treating carcinomas with 70-Mev x rays produced in a synchrotron are reviewed. The operational aspects of the synchrotron are outlined. Techniques for measuring the beam's optical and dose parameters are described. Methods used for x-ray and neutron dosimetry in air, as well as methods used for dosimetry in phantom substances, are summarized. Radiobiological studies are reported, including studies of the acute, delayed, and late somatic effects of x rays; investigations of possible life shortenings in man following radiation therapy; and studies of radiation genetics. (T.F.H.)

4010 (JPRS-10883) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 2, 1-96(Feb. 1961). 166p.

4011 (JPRS-10884) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 1, 1-98(Jan. 1961). 166p.

4012 (JPRS-10917) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 4, 1-98(Apr. 1961). 167p.

4013 (JPRS-11077) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 5, 1-99(May 1961). 173p.

4014 (JPRS-11221) PROGRESS OF MODERN BIOLOGY. Translation of Uspekhi Sovremennoi Biol., 52: 19-78(1961). 79p.

Translations are presented for four papers which appear consecutively on pages 19 to 78 of the 52nd volume of

Uspekhi Sovremnnoy biologii. Separate abstracts were prepared for two of the papers. The other two papers deal with anti-bodies and anti-body enzymes. (D.L.C.)

4015 (JPRS-11221(p.47-60)) RADIATION DISTURBANCES OF IMMUNITY IN THE LIGHT OF MODERN METHODS OF IMMUNITY. V. L. Troitskii (Troitskiy). Translated from Uspekhi Sovremennoi Biol., 52: 53-64 (1961).

An extensive review is presented of facts in immunology, with special reference to radiation effects. Irradiation of immunized animals frequently results in lowered immunity but no changes in anitbody content, which shows that resistance is not caused solely by antibodies and that irradiation disturbs the natural defense mechanisms. Modern theories of antibody formation are described in some detail, and known facts on radiation effects on antibody formation are compared with the indirect matrix theory and the clonal selection theory. It is concluded that the indirect matrix theory is more likely and that antibody formation probably takes place in lymphoid cells. (D.L.C.)

4016 (JPRS-11419) MEDICAL RADIOLOGY. Translation of Med. Radiol., 6: No. 7, 3-98(July 1961). 177p.

Translations are presented for 23 articles which deal with radiotherapy, radiation effects and sickness, radiobiology, and other related subjects. (D.L.C.)

4017 RADIATION BEHIND A GRID DURING ROENTGENOGRAPHY. Bengt Bjaerngard and Gunnar Hettinger (Univ. of Lund, Sweden). Acta Radiol., 56: 377-84(Nov. 1961). In English)

The composition of the radiation behind a diagnostic grid was studied with a scintillation spectrometer. The quantity and quality of the secondary radiation generated in the grid was estimated. In a practical case the grid radiation amounted to about 10% of the secondary radiation behind the grid. (auth)

4018 X-RAY INDUCED DEFICIENCIES OF CHROMOSOME 11 IN THE TOMATO. Charles M. Rick and Gurdev S. Khush (Univ. of California, Davis). Genetics, 46: 1389-93(Nov. 1961).

The tomato linkage group V, including the markers a_1 and hl, was identified with chromosome 11 by means of the radiation-induced deficiency method. Terminal deficiencies were induced in both arms and an interstitial deficiency in one arm of chromosome 11, and plants monosomic for this chromosome were also cytologically identified in the progeny. The gene a_1 resides in the achromatic region of the long arm and hl in either the achromatic or chromatic close to the junction of the two in the short arm of chromosome 11. The significance of survival of tomato monosomics in this test is discussed. (auth)

4019 TREATMENT OF MEATS WITH IONISING RADIATIONS. VIII. pH, WATER-BINDING CAPACITY AND PROTEOLYSIS OF IRRADIATED RAW BEEF AND PORK DURING STORAGE, AND THE ATP-ase ACTIVITY OF IRRADIATED RABBIT MUSCLE. R. A. Lawrie, J. G. Sharp, J. R. Bendall, and B. Coleby (Low Temperature Research Station, Cambridge, Eng.). J. Sci. Food Agr., 12: No. 11, 742-51(Nov. 1961).

The immediate effects of 5-Mrad ionizing radiation on beef and pork longissimus dorsi muscles were an increase in pH, a decrease in water-holding capacity, in increment in gel-volume for a given pH rise, and in soluble protein, and increased resistance to low- and high-speed homogenization. The indications of cross-binding induced by irradiation were supported by studies of isolated myofibrils from rabbit psoas muscle. Irradiation markedly reduced the syneresis (18°, $\mu = 0.04$) and the swelling (0°, $\mu = 0.25$) induced by ATP and, to a lesser extent, over-all fibrillar ATP-ase activity (the initial fast phase being depressed more than the slower second phase of the reaction). On storage (at −20° to +37°), pH and water-binding capacity increased generally with increase of temperature. Changes in pH occurred earlier with pork and to a greater extent than with beef. In sterile beef longissimus dorsi (irradiated or unirradiated) there was a decrease in soluble protein during storage for 60-90 days at 37° (indicating denaturation) and increases in TCA-soluble nitrogen and tyrosine (indicating proteolysis, which was more marked in unirradiated samples). The absence of soluble hydroxyproline and the presence of clearly marked cross-striations indicated that the autolysis must have involved sarcoplasmic and not fibrillar or connective tissue protein. (auth)

Biochemistry, Nutrition, and Toxicology

4020 (A/AC.82/G/L.665) STRONTIUM 90, STABLE STRONTIUM AND STABLE CALCIUM IN SOIL, FOOD ITEMS, WATER AND HUMAN BONE IN EGYPT (U.A.R.). K. A. Mahmound, M. K. Molokhia, and A. T. A. Abdel Fattah (United Arab Republic. Atomic Energy Establishment, Inshas, Egypt). Aug. 1961. 9p.

Of all the items analyzed for Sr^{90}, edible leaves of the vegetables, molokhia and gargeir, were found to have the highest concentration of Sr^{90} per unit weight. This is generally attributed to the foliar retention of fall-out and aerosol which are not diluted by natural Sr or Ca in the soil. The Sr^{90} per unit weight for tomatoes was found to be relatively small. Salt water samples procured from the Red Sea at Ghurdaka were found to contain reasonable amounts of Sr^{90}, while sweet water of the Ismailia Canal gave relatively smaller values. The experimental data on the human adult femur and vertebra were found to indicate a very small value of Sr^{90} in Sunshine Units. All of the samples were also assayed photometrically in order to assess the amount of stable Sr and Ca present. The data are tabulated. (P.C.H.)

4021 (BNL-685) CURRENT IDEAS ON THE ENDOCRINE REGULATION OF CELLULAR PROCESSES. Brookhaven Lecture Series Number 2, December 14, 1960. Irving L. Schwartz (Brookhaven National Lab., Upton, N. Y.). Nov. 1961. Contract [AT(30-2)-Gen-16]. 22p.

The operation of the endocrine system and its comparison with the nervous system are discussed. Endocrine regulation of cell activities is described. The relationship between chemical structure and biological activity of hormones is discussed. Studies of the interactions of hormones with cellular components are described. (M.C.G.)

4022 (NP-tr-825) THE EFFECT OF DIETHYLENETRIAMINEPENTAACETIC ACID ON THE RESORPTION OF RADIOCERIUM FROM AN INTRAMUSCULAR DEPOSIT. A. Catsch and H. Kiefer. Translated by M. Tomlinson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Experientia, 17: No. 1, 22-3 (1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract No. 14095.

4023 THE STABILITY OF ACCUMULATION COEFFICIENTS FOR Sr^{90}, Y^{91} AND Ce^{144} IN SEA ALGAE. G. G. Polikarpov (Kovalevskii Sevastopol Biological Station, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 1192-4(Oct. 11, 1961). (In Russian)

Samples of Cystoseira barbata and of a large brown seaweed from the Black Sea (Cystoseira) were grown in 2.5-liter, glass aquariums containing 10^{-5} curies/l of Sr^{89} and Ce^{144} (10^{-6} and 10^{-9} g/l respectively). The activity content of Sr^{90} and Ce^{144} was kept at the same level by adding 2.5×10^{-5} curies to each aquarium each day. Distribution coefficients were determined at different concentrations of activity in order to find out whether there was a variation in the distribution coefficient as a function of concentration. Equilibrium was attained in two days for Sr^{90} and in six days for Ce^{144}. It was found that the distribution coefficients remained constant for Sr^{90}, Y^{91} and Ce^{144} within the limits of experimental error. The distribution coefficients were found to be 300 for Sr^{90} and 2100 for Ce^{144}, and did not vary significantly whether the experiment was run with a single dose of tracer or with a multiple dose of tracer. Thus, the distribution coefficients were found to be stable in spite of a considerable variation in concentration of the isotopic carrier. (TTT)

4024 THE PARATHYROIDS AND THE INTESTINAL ABSORPTION OF CALCIUM, STRONTIUM AND PHOSPHATE IONS IN THE RAT. R. H. Wasserman and C. L. Comar (State Univ. Veterinary Coll., Ithaca, N. Y.). Endocrinology, 69: 1074-9(Dec. 1961).

The effect of parathyroidectomy (PTX) on the intestinal absorption of calcium, strontium, and phosphate ions was investigated in vivo and in vitro in the rat. At either 5 or 24 hours after parathyroidectomy, the plasma calcium was significantly decreased in comparison to the controls (mock operated) which indicated the success of the operation. It was observed that PTX did not alter the degree of absorption of Ca^{45}, Sr^{85}, or P^{32} by rat duodenum and ileum in vivo. In rats raised on a high calcium diet, there was an apparent slight decrease in deposition of Ca^{45} and Sr^{85} in the femur; in rats given a low calcium diet for two weeks, PTX did not influence femur deposition of alkaline earths in respect to the controls. In vitro studies with isolated everted gut segments indicated that the transfer of Ca^{45} and Sr^{85} across the duodenum and ileum was not influenced by the parathyroid status of the donor rat. (auth)

4025 EFFECT OF HYDROCORTISONE ON UPTAKE OF IRON-59 IN INCUBATED RAT RED CELLS IN VITRO. Peggy Clark (New South Wales Red Cross Blood Transfusion Service, Sydney). Nature, 192: 667-8(Nov. 18, 1961).

Hydrocortisone added to blood containing reticulocytes in a suitable substrate did not alter the rate of synthesis of hemoglobin and no evidence was obtained that it influenced the rate of ripening of reticulocytes. This applied to various dosage-levels in vitro and to plasma obtained from rats which were injected with large doses of hydrocortisone. It was shown, however, that preliminary incubation of reticulocytes with hydrocortisone before the addition of iron-59 reduces the amount of iron-59 which enters the reticulocytes. (N.W.R.)

4026 AN EXPERIMENTAL STUDY OF THE DISTRIBUTION OF RADIOISOTOPES IN THE BODY OF ANIMALS, WITH SPECIAL REFERENCE TO INTAKE THROUGH TRACHEA. T. Sato (Tokyo Univ.). Nippon Geka Gakkai Zasshi, 60: 2164-74(1960).

A complete tracheal fistula was made in the rabbit's neck. Through the fistula, P^{32}, Sr^{89}, and other fission products were given to rabbits. A large amount of P^{32} was distributed in the bones, liver, and muscles, and more rapid absorption resulted than in the cases of peroral and intramuscular administration. Sr^{89} showed the most deposition in the bone when the fission products were given through the fistula. Regardless of the administration methods, the fission products were mostly distributed in the bones and partly in the soft tissue. These radioactive substances were absorbed through the alveolar walls of the lung. It is concluded that there may exist a possibility of entrance of radioactive substances into the living body through the air path. (Abstr. Japan Med., 1: No. 13, 1961)

4027 BALNEOLOGIC STUDY BY RADIOISOTOPES. X. PERCUTANEOUS RESORPTION AND EXCRETION OF Na^{24} WITH SPECIAL REFERENCE TO THE INFLUENCE OF REPEATED SALT BATHS. R. Maruyama (Tokyo Univ.). Nippon Onsen Kika Gakkai Zasshi, 24: No. 1, 1-18(1960).

Mice were treated in a salt bath containing Na^{24}, and the ashes of the skins were measured for radioactivity by the scintillation counter. The amounts of Na^{24}, taken in through the skin, were larger when the pH of the salt bath was higher, when the concentration was increased from 0.1 to 2.0 g/l (no increase was seen between 2.0 to 10.0 g/l) and when the bathing time was longer. When $CaCl_2$ was added to the salt solution, the amount of Na^{24} uptake per bath decreased, but the uptake became constant after 3 weeks following stopping of the bath. The same phenomena due to repeated baths gradually disappeared after stopping the baths, and it returned as usual after 3 weeks following stopping of the bath. When the $CaCl_2$ baths were continued for a week, the Na^{24} uptake through the skin decreased. (Abstr. Japan Med., 1: No. 13, 1961)

4028 INVESTIGATIONS ON THE BIOLOGICAL BEHAVIOR OF RADIOACTIVE FISSION PRODUCTS IN PREGNANT ANIMALS. II. PLACENTAL TRANSFER OF RADIOCESIUM IN THE RAT. Heinz Kriegel and Elisabeth Weber (Heiligenberg-Instituts, Heiligenberg, Ger.). Strahlentherapie, 116: 50-6(Sept. 1961). (In German)

The placental transgression of Cs^{137} in rats was examined in dependence on the incorporation day before and during the gestation period. The later the incorporation takes place during the gestation the higher is the Cs content in the embryo, ante partum. There was a positive correlation between the Cs content in the embryo (% of the injected dose) and its weight, but the dependence of the Cs concentration (% of injected dose pro 100 mg tissue) of the embryonic weight was not recognizable. With a rising dose, the Cs content in the fetus increased correspondingly. It is supposed, that the placenta practices a regulating influence on the passage of the Cs ions. (auth)

Fallout and Ecology

4029 (TID-12946(App.I, Vol.I)) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. APPENDIX 1, SCIENTIFIC REPORTS, VOLUME 1. Appendix to Progress Report, September 1, 1960–August 31, 1961. John H. Ryther and David W. Menzel (Bermuda Biological Station, St. George's West). June 1, 1961. Contract AT(30-1)-2646. Includes Reprints: ECOLOGY OF RECENT PLANKTONIC FORAMINIFERA. PART 2. Allan W. H. Bé. Micropaleontology, 6: No. 4, 373-92 (Oct. 1960). NITROGEN FIXATION IN THE SARGASSO SEA. R. C. Dugdale, David W. Menzel, and John H. Ryther. Deep-Sea Research, 7: 298-300(1961). 102p.

Anomalously high surface concentrations of phosphates in sea water are hypothesized to be caused by the presence of surface-active binders. Various sources of nitrogen, both organic and inorganic, for marine centric diatoms are compared. The oxidation of ammonia in sea water is studied. Various studies are conducted in the waters off Bermuda, including: the effects of nutrients and vertical

mixing of the euphotic zone for the winter bloom; the bathymetric and seasonal distributions of 15 species of planktonic foraminifera; the fixation of N by the Trichodesmium plankton; the seasonal and anomalous variations in the temperature and salinity of the upper 500 m of sea water; and the adaptation of photosynthesis to seasonal light changes, and the variations in the chlorophyll content of the plants in response to nutrient changes. (T.F.H.)

4030 (TID-12946(App.1, Vol.II)) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. APPENDIX 1, SCIENTIFIC REPORTS, VOLUME 2. Appendix to Progress Report, September 1, 1960–August 31, 1961. John H. Ryther and David W. Menzel (Bermuda Biological Station, St. George's West). June 1, 1961. Contract AT(30-1)-2646. 92p.

An inexpensive lucite water sampler with a 28-liter volume is described. Studies are made of the feasibility of using Fe^{59} and Zn^{65} as tracers to measure the uptake of Fe and Zn by phytoplankton. The chemistry and plankton production in the tropical Atlantic off Barbados are investigated. Several studies are undertaken in the Sargasso Sea, including: seasonal variations in the abundance and composition of zooplankton; occurrence of ammonia in sea and rain water; occurrence of Fe and vitamin B-12 in sea water; and the effects of enriching the sea water with various nutrients of the production and species composition of the phytoplankton. (T.F.H.)

4031 (TID-12946(App.2)) THE BIOCHEMICAL CIRCULATION OF ELEMENTS IN THE SARGASSO SEA. APPENDIX 2, REDUCED DATA. Appendix to Progress Report, September 1, 1960–August 31, 1961. John H. Ryther and David W. Menzel (Bermuda Biological Station, St. George's West). July 1, 1961. Contract AT(30-1)-2646. 56p.

Reduced data on temperature, salinity, dissolved O, and total P content of the sea water at Station S (off Bermuda) taken from June 1954 to Oct. 1957 are presented. (T.F.H.)

Radiation Effects on Living Tissues

4032 (TID-13959) INVESTIGATIONS ON MUTABILITY OF POLYGENES. Summary of the Results up to September 30, 1961 (Nine Months of the Term of Contract). R. E. Scossiroli (Pavia, Italy. Università. Istituto di Genetica). Oct. 1, 1961. Contract AT(30-1)-2686. 14p.

Estimates on spontaneous mutability for polygenes, data on the relation between dose of radiation applied to seeds in plants and to the male gametes in Habrobracon and increase of the genetic variance, estimates of the dose necessary to double the genetic variance for quantitative traits, and evaluation of the degree of utilization of the induced genetic variability are reported. In the experiments on tomato plants, a radiation damage on the R_1 was made evident by the decrease in height of the 26 day old seedlings. The number of flowers on the main axis of the R_1 plants and the rate of flowering both showed an heterotic effect. Results of the irradiation of alfalfa seeds show that the flowering time of plants obtained from treated seed is delayed according to the dose applied. The number of stems per plant is increased in two varieties, and the weight of the plant increases at the subsequent cuts in the control plants. As a result of the experiments on Habrobracon juglandis two working hypotheses are proposed concerning inbreeding. (P.C.H.)

4033 (USNRDL-TR-532) ACCELERATED INDUCTION OF NEOPLASMS IN MOUSE KIDNEYS X-IRRADIATED (690 r) WHILE UNDERGOING COMPENSATORY HYPERPLASIA. V. J. Rosen and L. J. Cole (Naval Radiological Defense Lab., San Francisco). Oct. 11, 1961. 24p.

Groups of young adult $(C57LxA)F_1$ mice were subjected to several different treatments: 690 rad whole-body x-irradiation; unilateral nephrectomy and no irradiation; 690 rad irradiation followed by unilateral nephrectomy 1 hour later; unilateral nephrectomy followed by 690 rad irradiation 3 hours later; unilateral nephrectomy, 690 rad 3 hours later. The mice were examined 1 year later for kidney neoplasms. The group nephrectomized and irradiated 3 hours later showed a high incidence (5 out of 11) of kidney adenomas, as compared with none in the mice irradiated only, or nephrectomized only. In addition, a high incidence (6 out of 10) of tubular or capsular renal proliferations was observed in the mice subjected to irradiation first and nephrectomy 1 hour later. These proliferations are considered to be early stages in the evaluation of the frank renal adenoma. Since the accelerated induction of kidney neoplasms observed, occurred under conditions which inhibit mitotic activity and compensatory hypertrophy in the mouse kidney, it was proposed that the development of these renal neoplasms was the consequence of a prolonged imbalance between the stimulus to mitosis or regeneration on the one hand, and the capacity for mitosis or regeneration, on the other. (auth)

4034 (JPRS-10843) THE TOXICITY FOR PARAMECIA OF THE PLASMA OF HEALTHY AND IRRADIATED RATS AFTER BEING BURNED, INJURED, AND STARVED. G. A. K. Dzhafarov. Translated from Patol. Fiziol. i Eksptl'. Terap., 5: No. 4, 70-1(July-Aug. 1961). 4p.

The toxic effects of blood serum from healthy rats, mice, rabbits, and monkeys caused the death of paramecium in 6 to 12 min, while plasma from irradiated animals caused death in 2 to 7 min. Results are presented from studies on the toxic effects of serum from animals suffering from burn sickness, trauma, and starvation, alone and combined with radiation injuries. Results led to the conclusion that the toxic substances resulting from irradiation differ in their reaction mechanisms from those resulting from the other conditions studied. (C.H.)

4035 (JPRS-10914) NEW DATA ON THE EFFECT OF IONIZING RADIATION ON THE ENDOCRINE SYSTEM. D. E. Grodzenskii (Grodzenskiy). Translated from Problemy Endokrinol. i Gormonoterap., 7: No. 4, 26-32(July-Aug. 1961). 15p.

Data are summarized from a series of experiments on the early effects of irradiation on the endocrine system in rats. Particular attention was paid to the reaction of the adrenal hypophysis to irradiation. (C.H.)

4036 (JPRS-11109) CERTAIN DATA ON THE BIOLOGICAL EFFECT OF THERAPEUTIC DOSES OF RADIOACTIVE IODINE UPON AN ORGANISM UNDER EXPERIMENTAL CONDITIONS. Yu. A. Romanov. Translated from Problemy Endokrinol. i Gormonoterap., 7: No. 3, 22-31(May-June 1961). 17p.

I^{131} doses of 160 to 165 mc, equivalent to maximum therapeutic doses, are highly harmful to two-months old Chinchilla rabbits and inhibit the regenerative processes in the thyroid. In some cases these doses may cause hypothyreosis. Between the 30th and 90th day of the experiment a marked reduction of the thyroid weight was observed in animals which had received I^{131}. This was observed during the period when the thyroid becomes virtually free of I^{131}. It has been experimentally confirmed that the clinically

known state of temporary hyperthyreosis takes place during the first few weeks following I^{131} administration. Toward the end of the first month, following administration of 160 to 165 mc of I^{131} to animals, a hyperchromic anemia developed the appearance of which can be connected with the increased thyroid function. The condition of reticulocytes at this stage attested to a certain inhibition of erythropoiesis. Starting with the 30th day, and up to the end of the experiments the quantity of erythrocytes and reticulocytes gradually reverted to norm. During the entire experiment no deviations from norm were observed in the Hb content. Normalization of the red blood during the 2nd and 3rd month of the experiment, observed in I^{131}-treated animals, does not permit the conclusion of the presence of hypothyreosis in these animals, although in some rabbits toward the end of the experiment the thyroid was four times smaller as compared to control. On the basis of the data on the state of blood, obtained upon examination of a hypothyreosis animal, the possibility can be assumed of utilizing the blood picture for the diagnosis of hypothyreosis in the I^{131} treatment of thyreotoxicosis patients. (auth)

4037 (JPRS-11168) CHANGES IN THE HYPOPHYSO-ADRENAL SYSTEM UNDER THE EFFECT OF IONIZING RADIATIONS UPON THE ORGANISM. V. I. Kandror. Translated from Problemy Endokrinol. i Gormonoterap., 7: No. 3, 117-24(May-June 1961). 18p.

Data are summarized from a literature survey on the effects of radiation on the function of the adrenal glands. Most of the data indicate the initial reaction of the hypophyso-adrenal system to irradiation consists of the intensification of its activity. Some contrary results are described. (115 references.) (C.H.)

4038 (JPRS-11221(p.61-78)) TRANSPLANTATION OF HEMOPOIETIC TISSUE TO IRRADIATED ANIMALS. E. (Ye.) A. Luriya. Translated from Uspekhi Sovremennoi Biol., 52: 65-78(1961).

An extensive review is presented of results of research carried out on the transplantation of hemopoietic tissue, particularly bone marrow, to irradiated animals. The mechanism of the protective action of bone marrow, secondary reactions, radiochimeras, and bone-marrow therapy are discussed. (D.L.C.)

4039 (NP-tr-824) EXTERNAL DOSE. M. Fujita and H. Yamamoto (Japan Atomic Energy Research Inst., Tokyo). Translated by D. Jackson (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from report JAERI-5002(p.97-101). 1960. 13p. (Includes original, 5p.).

The relation between a radiation dose measured by a film badge and a dose absorbed by the body is discussed. Data were obtained for gamma and x radiation. Methods of finding the dosages from beta, gamma, and x radiation separately and mixed using film badges are described. The development of a badge for measuring a large neutron dose is discussed. (M.C.G.)

4040 INFLUENCES OF β-RAYS UPON TISSUE RESPIRATION. [PART] II. M. Asahina, W. Masuoka, K. Nishiwaki, A. Mori, and N. Kitamura (Okayama Univ., Japan). Ann. Hyg. Lab. Okayama Prefecture, 9: 11-14 (1959).

After injury of the liver tissue respiration by injection of P^{32} solution, the effects of cystine, cysteine, glutathione, vit. K, chlorophyll, ethyl alcohol, and glucuronic acid were studied. It was concluded that adequate amounts of ethyl alcohol and of glucuronic acid were effective against radiation damage to the tissue respiration. (Abstr. Japan Med., 1: No. 13, 1961)

4041 A CONTRIBUTION TO THE PROBLEM OF RADIATION RISKS. SUMMARIZING SURVEY OF LATE RADIATION DAMAGES ON THE BASIS OF NEW REPORTS. H. Langendorff. Atomkernenergie, 6: 366-74(Sept. 1961). (In German)

A review is given of recent studies on the problem of long-term effects of ionizing radiations from external sources, e.g., life-shortening, leukemia, tumorgenetic effects, cataract, fertility, premature aging, and pathologic effects in general. It is shown that all studies up to the present time are not able to give definitive information with regard to the late effects and that it is not possible to evaluate the possible hazard of exposure especially to low doses and low dose levels. Therefore, the results of these studies cannot absolutely be considered as a base for recommendations of radiation protection. (auth)

4042 THE EFFECT OF IONIZING RADIATION ON ACETYLCHOLINE METABOLISM IN MACACA-RHESUS MONKEYS. N. N. Demin, N. V. Korneeva, and V. A. Shaternikov (Inst. of Experimental Pathology and Therapy, Academy of Sciences, Sukhumi, USSR). Biochemistry (U. S. S. R.) (English Translation), 26: 439-42(Nov.-Dec. 1961).

In macaca-rhesus monkeys the normal content of free acetylcholine in the mucosa of the small intestine was higher, as it was in brain and liver, than bound acetyl choline. The total cholinesterase activity and, particularly, the activity of acetylcholinesterase and non-specific cholinesterase in control monkeys is highest in brain, followed by intestinal mucosa and liver. One to three days after γ-irradiation of the monkey at a dose of 600 r the amount of free and bound acetylcholine in the mucosa of the small intestine increased, while it decreased in liver. The total cholinesterase activity in the mucosa of the small intestine during this period increased, in general because of the increase in the activity of non-specific cholinesterase. In the liver the increase in total cholinesterase activity also occurred because of an increase in non-specific cholinesterase activity, but was less clear-cut and occurred later (the third day after irradiation). In animals irradiated 2 to 3 years before the investigation, an increased concentration of free acetylcholine in brain, liver, and mucosa of the small intestine was noted; but there were no changes in bound acetylcholine. The total cholinesterase activity increased in liver as a result of acetyl cholinesterase increase and non-specific enzymes, and in mucosa of the small intestine only as a result of acetylcholinesterase activity. In brain the total cholinesterase activity decreased as a consequence of a decrease in acetylcholinesterase activity. (auth)

4043 SENSITIVITY TO X RAYS OF YEASTS LABELED WITH P^{32}. Ethel Moustacchi and Herbert Marcovich (Institut Pasteur, Paris). Compt. rend., 253: 1183-5(Sept. 4, 1961). (In French)

Yeast cells without buds and in division are equally sensitive to the lethal action of incorporated P^{32}. The disintegration suppresses the difference in sensitivity to x rays between cells in the vegetative phase and in the division phase. A hypothetical phosphorated structure of the yeasts without buds would be responsible for the radiosensitization and would cease to intervene at the moment of the division. (tr-auth)

4044 STUDY ON THE METABOLISM OF γ-IRRADIATED ANIMALS. I. RESPIRATORY METABOLISM.

K. Hirano and H. Takayama (Osaka Univ.). Daigaku Igaku Zasshi, 11: 5725-9(1959).

Rats and mice were irradiated by whole-body gamma-ray exposure of 1500 r. A loss of weight definitely occurred in the exposed animals and was exaggerated just before death. The respiratory oxygen volume was slightly increased temporarily after irradiation as compared with that before irradiation. The oxygen volume decreased daily. The respiratory rate was not influenced by irradiation. The blood sugar also increased temporarily after irradiation. (Abstr. Japan Med., 1: No. 13, 1961)

4045 THE COMPENSATION MAGNITUDE IN SPATIAL INHOMOGENEOUS WHOLE-BODY IRRADIATION. F. Gauwerky and F. Heinzel (Allgemeine Krankenhaus St. Georg, Hamburg). Fortschr. Gebiete Röntgenstrahlen u. Nuklearmed., 95: 299-313(Sept. 1961). (In German)

According to published references on indirect effects of radiation and from the authors' own measurements on inhibitory effects retarding the natural growth of bones, the biological effect which compensates for radiation damage is understood as a control mechanism which has its source in the non-irradiated volume of the reaction system and in many cases in the immediate neighborhood (local effect). This effect has, therefore, centripetal direction in contrast to diffusion processes. It reduces the harm without effecting a full cure. A series of tests were made on mice to determine the mortality rate as a result of filtered whole-body irradiation and unfiltered whole-body irradiation. The tests confirmed that there exists for this multipolar model a unity of measurement clearly independent of the organ. The degree of compensation, that is the protective action resulting from this compensation, is estimated between 1.5 and 2.5. The experimental results show that the doses per volume were increased with the conditions of filtered irradiations. This value is the same or higher than that obtained from the best chemical protective substances. For the radiation doses studied, (beginning with applied doses of 450 to 1000 R with a whole-field irradiation), the compensation value increases (it is here represented by the integral of the survival quotient) as would be expected from the test results on the radiation-induced inhibition of bone development. (tr-auth)

4046 EFFECT OF X-IRRADIATION ON ASCITES TUMOURS. DIFFERENCE IN RADIOSENSITIVITY AMONG VARIOUS TRANSPLANT STRAINS OF ASCITES HEPATOMA OF THE RAT (ENGLISH TEXT). Y. Irako (Medical Inst. of Sasaki Foundation, Tokyo). Gann, 51: No. 1, 33-45 (1960).

By comparing the x-ray dose necessary to kill 10% of the cells of every tumor strain, the individual differences in radiosensitivity of 20 strains of the rat ascites hepatomas were investigated. These tumor strains had all been common naturally in the normal ancestral cell, the liver cell. The slower growing tumors were more radiosensitive than the faster growing tumour. This result did not support Bergonié-Tribondeau's law. X irradiation induced more remarkable damages in tumors showing more marked polymorphism of cells than in the tumors which consisted of uniform cells. No correlation was found between the radiosensitivity of tumors and their sensitivity to NH_2 derivatives, anticancer drugs. (Abstr. Japan Med., 1: No. 13, 1961)

4047 THE EFFECT OF SINGLE GENE SUBSTITUTIONS ON RESISTANCE TO RADIATION IN MICE. Donald P. Doolittle (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Genetics, 46: 1501-9(Nov. 1961).

The results of irradiating animals differing at a single locus in each of five inbred strains of mice are presented. Substituting the short ear gene (se) for its normal allele (Se) in two strains affected radiation resistance, the nature of the effect depending on sex and on the genetic background. Radiation resistance was also affected when the black-and-tan gene (a^t) was substituted for its nonagouti allele (a) in the C57BL/6J genotype. When the hairless gene (hr) was substituted for its normal allele (Hr) the results were not clear, but this substitution may have an effect. There was no indication of an effect from substituting the chinchilla gene (c^{ch}) for the albino gene (c). The radiation resistance effects were obtained in adults; in general, younger mice did not show any effect. Sex is important in determining the effect of a given substitution on radiation resistance. (auth)

4048 X-IRRADIATION OF THE DEVELOPING MALE GERM CELLS OF TRIBOLIUM CONFUSUM. Daniel J. McDonald (Dickinson Coll., Carlisle, Penna.). Genetics, 46: 1511-17(Nov. 1961).

Young adult males of the flour beetle, T. confusum, have been shown to require about four days, following eclosion, to reach sexual maturity. Subjecting two or three day old males to 1450 or 2900 r of x rays depresses their fertility, as evidenced by the increase in the percentage of inviable eggs produced by their mates. This inviability, probably due in part to the induction of dominant lethals, reaches a maximum value 11 to 12 days following irradiation and then declines. In general, the pattern of response suggests that the various stages of spermatogenesis of T. confusum are differentially sensitive to x-rays. No evidence was found for recovery of irradiated sperm stored by females, or of extended effects on the fertility of the treated males. (auth)

4049 STUDIES OF SERUM PROTEIN IN SYPHILIS. III. EFFECT OF X-RAY IRRADIATION IN SYPHILIS OF EXPERIMENTAL RABBITS ON SERUM PROTEIN FRACTIONS AND WASSERMANN ANTIBODY. S. Abe (Kyoto Univ.). Hifuka Kiyo, 55: 236(1960).

X rays in a dosage of 400, 800 and 800 plus 600 r respectively were applied to the entire body and immediately thereafter inoculation with syphilis was done. A decrease in leukocytes parallel to the amount of irradiation was seen in all but the group given 400 r. The appearance of symptoms was somewhat late in the group given 800 r, but no difference was observed in the others. Wassermann antibody titer was somewhat decreased in the group given 800 r, but no difference was observed in the others. Total amount of serum protein was slightly increased in the group given 400 and 800 r, but a decrease was recognized in the group given 800 plus 600 r. Serum protein fractions revealed a decrease in albumin and α-globulin and an increase in β-globulin. These changes were great in those who received a large amount of irradiation. γ-Globulin increased slightly in the 400 r group, but a decrease was observed in the group given 800 plus 600 r. (Abstr. Japan Med., 1: No. 13, 1961)

4050 INFLUENCE OF RADIOACTIVE PHOSPHORUS ON THE LYMPHOCYTE. [PARTS] I-III. H. Kurihara (Hiroshima Univ.). Hiroshima Igaku, 8: 935-63(1960).

Lymphocytes, extracted from the lymph nodes, spleen, or thymus of rabbits, were suspended in blood serum, which contained a P^{32} solution. The number of mitochondria in the lymphocytes gradually diminished with lapse of time and the change was most appreciable in the case of a high concentration of P^{32} (100 μc/ml). No changes of neutral-red granules were found in lymphocytes of the lymph nodes and spleen, while those in the irritant form of lymphocytes were somewhat decreased. The survival time of lymphocytes was approximately coincident with the decay of the

mitochondria, except for immature lymphocytes in the thymus whose survival time was not influenced by P^{32}. (Abstr. Japan Med., 1: No. 13, 1961)

4051 EFFECTS OF WHOLE-BODY X-IRRADIATION ON THE ADRENAL GLAND IN WHITE RATS. II. MORPHOLOGICAL CHANGES IN THE ADRENAL GLAND, THYMUS, OVARY AND HYPOPHYSIS. I. Ishibashi (Hiroshima Univ.). Hiroshima Igaku, 13: No. 1, (Spec. Issue), 31-46(1960).

Normal mature female white rats (of the same litter) were irradiated with a single dose of 300, 600, and 1200 r and were examined histologically and histochemically. Adrenal gland: The 300-r exposed group showed mild degeneration and destructive changes in the glomerular layer cells 3 hours after irradiation. These, however, returned almost to the former normal state at 3 to 7 days after irradiation. The 600-r exposed group showed more severe pathological changes with continuing increase in lipid granules at 3 to 7 days after irradiation. The 1200-r exposed group showed only fine granules in the zona glomerulosa and zona fasciculata and 7 days later hardly any lipid granules were present in any of the cortical layers. The 1200-r exposed group showed, from 24 hours after irradiation, diffuse proliferation of the zona fasciculata and swelling of the cells. Thymus: The 300-r exposed group showed slight atrophy at about 6 hours after irradiation, and thereafter the changes became more marked with lapse of time. The boundary between the cortex and the medulla became indistinct and a considerable decrease was noted in the thymus cells. In the 600 r and 1200 r exposed group, almost all thymus cells disappeared from the cortex and medulla and the reticular cells became degenerated with considerable hyperemia and congestion following the irradiation. The decrease in DNA from 3 hours after irradiation was considerable; RNA in each exposed group, however, remained unchanged. The ovary: In the 600 and 1200 r exposed groups, almost all primitive ovicapsules and graafian follicles were destroyed and the corpus luteum became atrophied to a small size with marked congestion, though in the 300-r group these effects were less severe. The 300 r group showed a tendency toward recovery from about 3 days after the irradiation. The 600 and 1200 r groups showed a tendency to progressive cell decrease. The pituitary gland: Each group showed slight degeneration of the cells, marked hyperemia, and congestion in the insterstitium and a tendency to a slight increase in the α-cells and a decrease in the β-cells. (Abstr. Japan Med., 1: No. 13, 1961)

4052 CROSS-FERTILIZATION IN AUTOGAMOUS CULTURE, BY IRRADIATION OF CULTIVATED SEED. T. Orav (Institute for Experimental Biology, Academy of Science, Estonian SSR). Izvest. Akad. Nauk Eston. S.S.R., Ser. Biol., No. 2, 129-32(1961). (In Russian)

Previously published work mentioned that cross-fertilization could appear in autogamous cultures (barley, oats) as a result of irradiation in the generation M_1. The reason for this phenomenon, as given by Gaul and Mittelstenscheid, is that the individual pollen of the concerned plants was sterilized. Experiments were carried out in which the formation of hybrids was observed in gamma-irradiated wheat varieties seeded next to one another. In generations M_2 and M_3, among the descendants of the summer wheat, types of 'Diamant' plants were found in which the grain form and the astria length resembled the wheat variety 'Moskowka 48.' In the generation M_3, characteristics were established by some lines which confirmed the hybrid character of the changed forms. Also among the descendants of the irradiated seed of the wheat variety 'Kauka,' several individuals with the characteristics of the 'Diamant' type were found growing. It was assumed that the reason for such cross-fertilization of the autogamous cultures lies in the fact that the capability of selective fertilization belonging to the ovum is changed by irradiation. As an indirect evidence of this assumption can be applied the fact that by different plant forms because of irradiation, the tendency appears to overcome their common cross-sterilization. (tr-auth)

4053 TRANSPLANTABILITY OF SATO CARCINOMA NO. I ON PREVIOUSLY IRRADIATED MICE. Y. Suzuki (Chiba Univ., Japan). Koku Geka Gakkai Zasshi, 6: 101-16(1960).

This experiment was made in order to investigate the behavior of transplantable Sato carcinoma cells of mice inoculated into a site which had previously been irradiated by x rays. Previous total-body irradiation of 100 r and 300 r on mice had no influence on additionally inoculated tumor cells. Takes of tumor cells were not disturbed by any previous local irradiation of 100 r, 300 r, 900 r, 2000 r, or 3000 r, respectively. However, previous irradiation by a dosage higher than 900 r apparently had an inhibitory effect on the growth activity of the additionally inoculated tumor cells. Although these relations could not be differentiated by histological examination, this phenomenon was believed to develop as a result of the unfavorable conditions for the growth of the tumor cells, induced by previous x ray irradiation. (auth)

4054 HISTOPATHOLOGICAL STUDIES ON THE INFLUENCE OF Co^{60} IRRADIATION OF THE HINDLEGS OF GROWING MICE. T. Takemoto (Kurume Univ., Japan). Kurume Igakkai Zasshi, 23: 208(1960).

X-ray examination of the Co^{60}-irradiated mice showed inhibition of bone growth. The articular cartilages became thin, fibrous, and exfoliated. Chondrocytes became degenerated and decreased in number with loss of their enchondral processes. Collagenization, cleft formation, and interstitial hemorrhages were sometimes seen in the region between bone and cartilage. The primary spongy substance became coarse, massive, and shortened due to destruction by osteoclasts and finally disappeared. The secondary spongy substance became scanty, shortened and finally vanished. Osteoblasts seemed to be more sensitive to radiation. However, they were not completely lost, unless destruction of the bone marrow was very advanced. Bone marrow cells were easily destroyed. Hypoplasia of bone marrow cells occurred early after irradiation and later there was degeneration, fibrosis, and transformation into oedematous architectureless tissue. A marked reduction of vascular collagenous tissue was noted. Blood vessels showed congestion, dilatation, and occasional hemorrhage. These changes were more intense and earlier when the dose of irradiation was increased. The changes progressed gradually and there was almost never any recovery. The changes in the periosteum and cortical bone were not constant, being unrelated to the dose of irradiation. General irradiation produced more changes in the bone tissue than local irradiation. The inhibition of bone growth may be partly due to some, as yet unknown, general factors. The bone changes induced by Co^{60}-irradiation were milder than those due to x irradiation. (Abstr. Japan Med., 1: No. 13, 1961)

4055 EXPERIMENTAL STUDY ON UPTAKE AND DISTRIBUTION OF PHOSPHORUS IN ORGANS OF IRRADIATED MICE. D. Aoyama (Kyoto Prefectural Univ.). Kyoto Furitsu Ikadaigaku Zasshi, 67: 473(1960).

P^{32} was injected intramuscularly (0.1 μc/g) in mice after

a whole-body x irradiation of 50 to 600 r, and then radioactivity in various organs and relative specific activities (RSA) were measured. In normal mice, different organs show different values of RSA. Effects of whole-body x irradiation on various organs and tissues varied with the time after irradiation. The spleen, bone marrow, and testis were extremely radiosensitive, and either less recovering tendency or none was found when a large dose was given. In these organs, the turnover rate of phosphorus appeared distinctly disturbed even 6 hours after x irradiation. Other organs showed a slight recovery reaction from radiation injury 24 to 36 hours after irradiation. The grade of radiation injury did not show an actual parallelism to the dose given, but it was evident that a large-dose irradiation resulted in gross changes. (Abstr. Japan Med., 1: No. 13, 1961)

4056 MEASUREMENT OF THE DOSE RECEIVED WITH VARIOUS METHODS OF ADMINISTRATION OF IONISING RADIATIONS. N. Macarini (Università, Genoa). Minerva nucleare, 5: 236-9(Oct. 1961). (In Italian)

The ultimate purpose of radiologic dosimetry is to measure quantitatively the action of ionizing radiations on living matter, referred to a universal linear scale by which different conditions of exposure (both in relation to the type of radiations used and to the degree and method of exposure) can be compared. However, the dosimetry of ionizing radiations is faced with considerable difficulties. In fact, considerable theoretical difficulties are involved as well as those connected with the experimental conditions; even some fundamental physical definitions have undergone a gradual change of late and are still a cause of disagreement. A comparison between the dosimetric conditions in internal and external radiotherapy would be very interesting. Unfortunately, such a comparison is at present possible only in an approximate manner and in special cases. Internal radiotherapy with artificial radionuclides differs from all other forms of radiotherapy in that the distribution of the sources of radiations within the body is based on biological processes which take place in the body itself. Apart from the difficulties encountered in comparing the doses quantitatively in terms of the amount of energy absorbed per unit volume of tissue, the main difficulties are due to our as yet imperfect knowledge of the biological behavior of the various radionuclides, and consequently, to the doubts which still exist in internal dosimetry on account of technical, physical, and mathematical problems. Any attempt to compare the dose in internal radiotherapy with radionuclides with the dose given with other techniques must be considered with due reserve. The numerous problems and difficulties in the dosimetry of internal radiations are described, and it is concluded that comparison of the doses administered internally and externally is still faced with considerable theoretical and practical problems. The considerable progress achieved during the past few years in the field of dosimetry thanks to the efforts of biologists, physicists and radiologists warrants the hope that these problems will soon be solved satisfactorily. (auth)

4057 CELLULAR DAMAGE, ESPECIALLY AS REGARDS VARIATIONS IN PERMEABILITY, IN RELATION TO VARIOUS TECHNIQUES OF IRRADIATION. O. Ferrini, P. Biassoni, and P. G. Menozzi (Università, Genoa). Minerva nucleare, 5: 239-45(Oct. 1961). (In Italian)

Previous observations have shown that ionizing radiations are capable of modifying the permeability to cations of various types of cells, especially the erythrocytes, even producing osmotic hemolysis. Some aspects of present theories on the selective intra- and extracellular cation distribution are discussed, especially the cytoplasmatic theory according to which the distribution of the electrolytes is interpreted as a function of the spatial structuration of the protein network of the cytoplasm. The results of personal investigations are reported, in which human erythrocytes were irradiated in vitro using the gamma radiations of radiocobalt (external irradiation) or the beta radiations of radioiodine and radiophosphorus (internal irradiation). The intracellular cation (Na^+ and K^-) content of the erythrocytes, and their permeability to pentoses (xylose) were investigated at different intervals after irradiation in parafisiological conditions (incubation at 37°C for various periods of time, in the presence of O_2 and with or without the addition of substrata). A tendency of the intra- and extracellular electrolyte gradients to level out (uptake of Na^+ and loss of K^-) was observed; this was proportionate, within certain limits, to the logarithm of the dose used. As compared with external irradiation, intracellular irradiation with I^{131} or P^{32} revealed comparable but quantitatively greater effects, although the range was less than 10 to 15% with both methods of irradiation. These differences can be explained by considering various variables connected with the different experimental conditions, essentially the time of exposure, the space distribution, and the linear transfer of the ionizing energy. (auth)

4058 INJURY TO THE HEMOPOIETIC TISSUES IN RELATION TO DIFFERENT TECHNIQUES OF IRRADIATION. C. Sacchetti and F. Diena (Università, Genoa). Minerva nucleare, 5: 245-62(Oct. 1961). (In Italian)

The factors involved in the appearance of cellular injuries due to irradiation, and the findings in the blood and bone marrow of experimental animals and man after different doses of radiations are considered. The criteria followed in the diagnosis of hemopoietic damage and in evaluating the duration of the injury and the degree of recovery are described. In this connection, the importance of investigation of the hemopoietic function in relation to the dynamics of the cells is stressed. The mechanism of cellular injury after internal irradiation and the radiosensitivity of the hemopoietic cells are discussed. The clinical picture of hemopoietic injury due to irradiation and the late complications are considered. (auth)

4059 HAEMATOLOGICAL INVESTIGATION OF ACUTE AND CHRONIC RADIATION LESIONS WITH SPECIAL REFERENCE TO THE THROMBOPOIETIC SYSTEM. I. EXPERIMENTAL STUDY. T. Matsuki (Kyoto Univ.). Naika Hôkan, 6: 47-61(1959).

Hematological observation following a single dose whole-body radiation with an x-ray dose of 30 to 2000 r was made on female rabbits. When a dose of 200 to 500 r was administered, the platelet count increased temporarily and then decreased. With a dose of 1000 to 2000 r the platelets decreased considerably. Parallel with the platelet count decrease there was an increase in the dimensions of the platelets and in the number of damaged platelets. The megakaryocyte count of the bone marrow decreased when over 200 r was given. Although the lymphocytes decreased in number after irradiation with only 30 r, the peripheral RBC and the Hb remained unchanged even after irradiation with 1000 r. (Abstr. Japan Med., 1: No. 13, 1961)

4060 STUDIES ON THE BIOLOGICAL EFFECTS OF NEUTRONS AND Co^{60} γ-RAYS IN MICE. II. BIOLOGICAL EFFECTS OF Co^{60} γ-RAYS IN MICE. T. Morii (Kyoto Univ.). Naika Hôkan, 6: 520-7(1959).

In group 1 after 2015 r and in group 2 after 1434 r x irradiation, severe intestinal damage and leukopenia were observed and all died with mean survival times of

4 days 6 hours and 5 days 17 hours, respectively. These changes seem to be comparable to those in mice which were irradiated by 1.1×10^{11}/sq cm neutrons. In group 3 irradiated with 672 r, though the radiation effects were not so injurious as those of groups 1 and 2, complete recovery was not attained by the 4th week. These changes seem to be more injurious than those in mice which were irradiated with 4.7×10^{10}/sq cm neutrons. (Abstr. Japan Med., 1: No. 13, 1961)

4061 STUDIES ON THE BIOLOGICAL EFFECTS OF NEUTRONS AND Co^{60} γ-RAYS IN MICE. III. PROTECTIVE EFFECT OF BIOLOGICAL AGENTS AGAINST RADIATION INJURY IN MICE. T. Morii (Kyoto Univ.). Naika Hôkan, 6: 585-96(1959).

Tissue homogenates were injected into mice irradiated with Co^{60} γ rays in the lethal range. In the intraperitoneally injected group, the spleen homogenate of the infant of the same strain gave the best result followed in order by that made from adult mice and bone marrow suspension. In the intravenously injected group, recovery of the peripheral reticulocytes occurred earlier when bone marrow suspension was used than with agents of other types. Generally, biological materials, such as spleen homogenate and bone marrow suspension, were effective in protection from acute Co^{60} γ radiation injury in mice. (Abstr. Japan Med., 1: No. 13, 1961)

4062 HAEMATOLOGICAL AND HISTOLOGICAL STUDIES IN THE OFFSPRING OF ALBINO RATS AFTER Sr^{90} ADMINISTRATION. [PART] II. K. Nishimura (Kyoto Univ.). Naika Hôkan, 6: 597-611(1959).

Rats, male and female, were injected with Sr^{90} in doses of 0.5–1.0 μc per gram of body weight and then interbred with Sr^{90}-injected rats or non-injected rats for the purpose of obtaining the first offspring. Then, by mating the albino rats born from the same mother, the span of four generations (F_1-F_4) was produced. In the peripheral blood of these albino rats, a considerable variation of the leukocyte count was observed. The bone marrow pictures of these albino rats suggested a maturation arrest in the neutrophils. Myeloid cell hyperplasia in the spleen was found in one case associated with splenomegaly, and myelogenous leukemia developed in another case. (Abstr. Japan Med., 1: No. 13, 1961)

4063 STUDIES ON THE INFLUENCE OF SMALL DOSAGE OF RADIATION UPON THE BLOOD. II. OBSERVATION OF PERIPHERAL LEUCOCYTES BY SUPRAVITAL STAINING IN NORMAL PERSONS AFTER CHEST X-RAY PHOTOGRAPHY AND GASTROINTESTINAL FLUOROSCOPY. Y. Nakamura (Kyoto Univ.). Naika Hôkan, 6: 861-72(1959).

The leukocyte count showed no remarkable changes. The number of neutral red vacuoles in the neutrophils was increased following x irradiation, while the number of mitochondria in lymphocytes was decreased and the neutral red vacuoles were increased. The refractiveness reached its maximum after 2 hr and returned to normal after 24 hr. Relative and absolute lymphocyte counts were increased, while the neutrophils were decreased in number. These changes reached their maximum after 3 hr and were still noticeable after 24 hr. Eosinophils and monocytes showed no change. The changes were not influenced by the difference of dosage of radiation. (auth)

4064 CLINICO-BIOCHEMICAL STUDY ON THE EFFECT OF Co^{60} γ-IRRADIATION ON MALIGNANT DISEASE. [PARTS] I-III. K. Maruyama (Yamaguchi Medical Coll., Ube, Japan). Naika Hôkan, 7: 238; 250; 257(1960).

In patients with malignant tumors on which Co^{60} γ-irradiation was effective (effective group), serum albumin was generally elevated to the normal level after irradiation. Serum globulin, which had been slightly increased before irradiation, was returned to normal. The serum cadmium reaction prior to irradiation showed a left reaction in 11 out of 21 cases in the effective group. However, this returned to normal limits in all patients after irradiation. In the non-effective patients (in which the tumor was not affected by Co^{60}-irradiation), the cadmium reaction was generally left. The Wuhrmann reaction appeared positive in 10 out of 21 cases in the effective group prior to irradiation. However, this positive reaction was rather decreased after irradiation. On the other hand, in the non-effective group, the reaction was strongly positive after irradiation. In both groups, the serum Takata reaction and the cephalin-cholesterol flocculation test were within normal limits before and after irradiation. (Abstr. Japan Med., 1: No. 13, 1961)

4065 CHROMATOGRAPHY AND NUCLEOTIDE SEQUENCES OF DEOXYRIBONUCLEIC ACID SYNTHESIZED IN SALMONELLA TYPHIMURIUM AFTER IRRADIATION WITH ULTRA-VIOLET. T. Hudnik-Plevnik and L. A. Stocken (Oxford Univ.). Nature, 192: 554-5(Nov. 11, 1961).

It is shown that ultraviolet radiation produces a temporary inhibition of desoxyribonucleic acid (DNA) synthesis in the bacteria Salmonella typhimurium. The synthesis is resumed after 30 to 60 minutes and proceeds at a rate similar to the control, but the surviving bacteria are growing only in mass, having lost their ability to form colonies. Thus results are presented of the chromatography and nucleotide sequences for the characterization of DNA from normal and irradiated Sal. typhimurium. The net results of the synthesis show that DNA formed in the irradiated bacteria is less stable and the turnover correspondingly greater, however, the synthesis is roughly the same in the two cases. (N.W.R.)

4066 INDUCTION OF TUMOURS IN MICE WITH TRITIATED THYMIDINE. Hermann Lisco, Renato Baserga, and Walter E. Kisieleski (Argonne National Lab., Ill. and Northwestern Univ. School of Medicine, Chicago). Nature, 192: 571-2(Nov. 11, 1961).

Preliminary results are presented of the incidence of tumors in mice after a single intraperitoneal injection of tritiated thymidine. Although the total number of tumors is small, there is evidence that the death rate from tumors is significantly higher among the exposed than among the control animals. The results indicate that, at this dose-level, tritiated thymidine is a carcinogen in mice. The following types of malignant tumors are observed among the experimental animals: thymic lymphoma; non-thymic, disseminated lymphoma; salivary gland tumor; carcinoma of the skin; carcinoma of the lung; and carcinoma of the liver. (N.W.R.)

4067 MOUSE LYMPHOMA CELLS WITH DIFFERENT RADIOSENSITIVITIES. P. Alexander (Royal Cancer Hospital, London). Nature, 192: 572-3(Nov. 11, 1961).

Cultures which contain murine leukemia cells are exposed to 220 kvp x rays in order to determine the radiosensitivity of the cells. Results show that the radiosensitivity of the cells changed on being continuously maintained in the culture. The change is probably due to mutations occurring during the growth of the lymphoma cells in the culture. The sensitive strain divides in culture about 25 per cent more rapidly than the insensitive and this presumably gives the cells a proliferative advantage so that they establish themselves in vitro on continued culture. The sensitive cells have retained their host specificity for

DBA/2 mice, but they grow less rapidly in mice than the resistant and give rise more frequently to solid tumors. The average volume of the sensitive cells is some 30 per cent greater than that of the resistant cells but the content of deoxyribonucleic acid is the same for both. In neither type of cell, when taken from culture or from animals, could any viruses be seen in the electron microscope. (N.W.R.)

4068 EFFECTS OF IODOACETIC ACID ON THE INCORPORATION OF PHOSPHORUS-32 INTO THE DEOXYRIBONUCLEIC ACID OF SOME RADIOSENSITIVE ORGANS IN RATS EXPOSED TO X-RAYS. M. Quintiliani, M. Boccacci, and L. Tentori (Istituto Superiore di Sanità, Rome). Nature, 192: 573-4(Nov. 11, 1961).

Results are presented on the effect of iodoacetic acid and x radiation on the uptake of phosphorus-32 into deoxyribonucleic acid of the thymus, spleen, and intestine of the rat. The results indicate that the combined treatment with iodoacetate (40 mg/kg) and x radiation (150 r) causes an inhibition of phosphorus-32 uptake into DNA corresponding nearly to sum of the inhibitions obtained by single treatments; the effect of iodoacetate decreases significantly a few hours after the administration of this substance, whereas at the same time interval the irradiation effect increases. (N.W.R.)

4069 PROTECTION BY INORGANIC CONDENSED PHOSPHATES AGAINST THE LETHAL EFFECTS OF X-RAYS. J. H. Barnes and J. St. L. Philpot (Medical Research Council, Didcot, Berks, Eng.). Nature, 192: 574-5 (Nov. 11, 1961).

Results show that sodium pyrophosphate, linear tripolyphosphate, and cyclic trimeta- and tetrametaphosphates markedly reduce the mortality in mice due to x rays when injected intraperitoneally in neutral solution, shortly before exposure. A comparison is made of trimetaphosphate and S, beta-aminoethylisothiuronium bromide hydrobromide (AET) in order to determine the highest protection given by the compounds. Results show that trimetaphosphate is significantly less protective than AET, but its lower fiducial limit, 1059 r, is well above the LD_{50} of uninjected mice of this strain, which is known to be about 860 r. (N.W.R.)

4070 INHIBITED OVIPOSITION BY FEMALES OF GRYLLUS ASSIMILIS (F.), INDUCED BY RADIOACTIVE MALES, USING L-METHIONINE-METHYL-^{14}C. A. A. Abdel-Malek and D. K. McE. Kevan (McGill Univ., [Montreal]. Nature, 192: 681-2(Nov. 18, 1961).

Results of matings between radioactive and normal or non-radioactive individuals of Gryllus assimilis (North American field crickets) are reported. The treatment of males with L-methionine-methyl-carbon-14 caused inhibition of egg-laying females and sterility of the male itself. This inhibited oviposition applies to both radioactive and normal virgin females when they are mated with radioactive males. However, if the female is mated with a normal male no effect is noticed in normal oviposition whether the female is normal or radioactive. As a matter of fact, it appears that the radioactive female lays more eggs when mated with a normal male. (N.W.R.)

4071 THE RADIATION SENSITIVITY OF CELL NUCLEOPROTEINS. Hanna Ernst (Heiligenberg-Institut, Heiligenberg, Ger.). Naturwissenschaften, 48: 575(1961). (In German)

An albumin-globulin fraction can be separated from sucrose-isolated cell nuclei. Histone can be separated from the nuclear residues. After whole-body irradiation of white mice, both these proteins showed immediate reduction in the spleen, thymus, and liver. The nuclear protein nitrogen/organ was also determined. The results show that the radiation damage in the liver is reversible, whereas in the spleen and thymus after a brief increase phase a further protein fraction reduction occurs. (J.S.R.)

4072 THE THERAPEUTIC EFFECT OF SPLENECTOMY ON RADIATION DAMAGE IN RATS. H.-J. Melching, O. Messerschmidt, and K. Shibata (Universität, Freiburg i. B. and Heiligenberg-Institut, Heiligenberg, Ger.). Naturwissenschaften, 48: 576-7(1961). (In German)

A study was made on the therapeutic effect of splenectomy on the irradiated rat. Female white mice were splenectomized one hour after 690 r whole-body x radiation. The results shows that a significant therapeutic effect in the sense of an increase of the survival rate could be shown after splenectomy. (J.S.R.)

4073 RADIATION EFFECTS ON THE UPTAKE OF RADIOACTIVE IRON (Fe^{59}) BY RAT BONE MARROW MEGAKARYOCYTES IN VIVO. S. K. Brahma, A. Bose, and S. Bose (Chittaranjan National Cancer Research Centre, Calcutta). Naturwissenschaften, 48: 582(1961). (In English)

A study was made to determine if radiation had any effect on Fe^{59} uptake in megakaryocytes. The results obtained were tabulated, and they show that Fe^{59} incorporation in the megakaryocytes of rat bone marrow in vivo is a radiosensitive process. (J.S.R.)

4074 AN EXPERIMENTAL STUDY ON THE FUNCTIONAL AND HISTOPATHOLOGICAL CHANGES IN THE PULMONARY LESION CAUSED BY X-IRRADIATION. K. Tamaki (Tokyo Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 19: 2090-2103(1960).

The lungs of rabbits irradiated with very large doses were examined functionally by bronchography and for tissue changes microscopically for 7 months. The irradiated lung tissue was characterized by a strong tendency toward degeneration or atrophy. Inflammatory and reparative changes were relatively not prominent. These changes developed over a long period of time and were mostly irreversible. In the irradiated area of the lung, the contrast medium (dionosil aqueous) was disturbed or delayed in entering or leaving the bronchi. Histopathological changes in the irradiated lung tissue were generally parallel to those of the functional changes. The long-continued retention of the contrast medium in the affected lung resulted in susceptibility to infectious diseases. (Abstr. Japan Med., 1: No. 13, 1961)

4075 EXPERIMENTAL STUDIES ON THE NATURE OF RADIATION HAZARDS. II. INFLUENCES OF CYTOTOXIN, PRODUCED AT THE TIME OF X-RAY IRRADIATION IN A LARGE DOSE, ON THE RECOVERY OF TESTICLE DISTURBANCES. S. Kojima (Okayama Univ., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 28-32(1960).

In rabbits injected with cytotoxin for 4 weeks, the histological picture of the testicle one month after the termination of the injection revealed a marked decrease in the number of spermatogenic cells and a uniform existence of spermatogonia, spermatocytes, and spermatozoa in seminiferous tubules. The majority of spermatogonia and spermatocytes were undergoing cell division. However, the picture two months after the termination of the injection showed hardly any difference from that of the normal testicles. From these results it is concluded that, in the animal treated with the cytotoxin, changes occur in the testicles similar to those in the testicles of the animals irradiated with x rays. When the injection of the cytotoxin is stopped, spermatogenic cells recover enough to regenerate again within one month after the cessation of the administration. (Abstr. Japan Med., 1: No. 13, 1961)

4076 INFLUENCE OF X-IRRADIATION UPON ACTIVITY OF CHOLINESTERASE IN LIVER AND SERUM. [PARTS] I-III. M. Ioroi (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 236-64(1960).

The activity of cholinesterase in the liver, studied in rabbits and rats, was more inhibited when the liver was irradiated by a single x-ray dose than by fractionated doses. With 100, 300, and 600 r of whole-body irradiation, the activity of cholinesterase in the liver was stimulated; meanwhile in serum it was inhibited. With 1000 and 2000 r, the activities in both serum and liver were severely inhibited. When the diencephalon and spinal cord were irradiated with fractionated doses (150 r twice a week), the activity of cholinesterase in both liver and serum showed no appreciable change. When whole-body irradiation (100 r per day) was given, the activity of cholinesterase in both liver and serum was somewhat stimulated. After liver irradiation (200 r per day; total dose 4000 r) the activity of cholinesterase in both liver and serum was inhibited. In patients who showed high activity of cholinesterase in serum before x-ray therapy, the activity was slightly inhibited after x-ray treatment, and patients who showed low activity before therapy were slightly stimulated after x irradiation. (Abstr. Japan Med., 1: No. 13, 1961)

4077 STUDIES ON THE EFFECT OF IRRADIATION ON URINE QUOTIENTS. S. Matsuoka (Hokkaido Univ., Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 337-45(1960).

The influences of x radiation on the value of vakat-O, the 4th iodate value (K_4), and the ratio of vakat-O to the 4th iodate value (O/K_4) were studied. In normal persons, vakat-O was 406 ± 22.0 kg/hr, K_4 12.1 ± 1.10 mg/hr, and O/K_4 32.7 ± 2.24. For the in-patients, vakat-O was 420 ± 23.6 mg/hr, K_4 8.9 ± 1.17 mg/hr, and O/K_4 54.2 ± 6.47. The vakat-O was the same as for normals but K_4 and O/K_4 were significantly different. The in-patients were not influenced by radiography, fluoroscopy of the abdomen, and x irradiation. Na/K and Na/Cl of the urine showed no definite tendencies in their changes by the x irradiation. In the groups showing abdominal values, O/K_4 increased markedly, but it cannot be attributed to x irradiation. Therefore, a single x irradiation of 200–300 r was not effective as a stress. (Abstr. Japan Med., 1: No. 13, 1961)

4078 EFFECT OF X-RAYS UPON THE TIME OF MITOTIC DIVISION OF YOSHIDA SARCOMA CELL. S. Koiwai (Sapporo Medical Coll.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 354-61(1960).

Cells were irradiated with 200, 500, and 1000 r by a contact x-ray unit, in hanging-drop preparations at a temperature of 35°C. Then the tumor cells were observed in a living state with a phase microscope. The times of mitotic division for 72 non-irradiated tumor cells were measured. When tumor cells became larger, the time of cell division became longer and this tendency was more marked when the diameter of a cell was more than 17 μ. Average time for a mitotic division was 85.2 ± 13.6 min. No effect was observed on cell division following x irradiation of dividing cells with 200 r, but when the cells were given more than 500 r, although times of cell division in anaphase and telophase did not change, those of prophase and metaphase became longer in comparison with the control group. Cells of irregular divisions in time or mode became numerous. (Abstr. Japan Med., 1: No. 13, 1961)

4079 EXPERIMENTAL STUDIES ON THE METABOLISM OF RADIO-RESISTANT TISSUES. T. Ishida (Kobe Medical Coll., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 378-89(1960).

For preliminary irradiation, the testicles of rabbits were irradiated with 10 and 20 r, respectively, 3 times at intervals of 7 days. Ten days later 600 r were given. These animals were compared with animals irradiated 10 days before and whose testicles had been irradiated once with a total dosage of 600 r. The pre-irradiated group of animals showed lower radiation sensitivity than the post-irradiation group. A biological resistance had developed. Those animals with pre-irradiation, thought to have resistance, showed lowered cellular respiration with elevated glycolysis, and the metabolism of resistant cells became predominantly glycolytic and showed less respiratory action. Mild difference of respiratory action and moderate difference in glycolytic action were observed between the animals pre-irradiated with 10 r 3 times and those with 20 r 3 times. The additional 600-r irradiation also resulted in a moderate difference. (Abstr. Japan Med., 1: No. 13, 1961)

4080 EFFECT OF X-RAY IRRADIATION ON THE HEART MUSCLE FIBRE. M. Kondo (Mie Prefectural Univ., Tsu, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 580-96(1960).

Using the supermicroelectrode method, action potentials of the heart muscle of dogs were studied. In the 1000 r–2000 r (40 kv, 1994.4 r/min) exposed group, no change was seen in potential but slight shortening or prolongation of the potential duration resulted. The threshold dose for the action potential seemed to be about 4000 r, as in 4000–8000 r exposed animals a diminution of the action potential and resting potential was observed. In the 10000–18000 r exposed group, the action potential and resting potential both disappeared completely within 60 min after x-ray exposure. Generally, the effect of x irradiation became increasingly pronounced with lapse of time up to one hour after exposure. As regards the temperature of Tyrode's solution, no difference in effects was discernible between the groups of 30 and 15°C. (Abstr. Japan Med., 1: No. 13, 1961)

4081 EXPERIMENTAL STUDIES ON THE EFFECTS OF AN INTRAVENOUSLY ADMINISTERED RADIOISOTOPE UPON THE FOETUS. E. Noma (Kobe Medical Coll., Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 597-611 (1960).

P^{32} was given in a dosage of 1.2 μc/g to 5 mice in the latter period of pregnancy, and its intrabodily distribution in mice and fetuses was investigated at 2.5 hours after injection. Further P^{32} was given in dosages of 2.4, 1.2, 0.5, and 0.3 μc/g, respectively, to 50 mice in the middle and latter period of pregnancy, and their 249 baby mice were morphologically examined periodically after birth. The intrabodily distribution in pregnant mice was similar to that in non-pregnant mice. When P^{32} was given in dosages of 1.2 μc/g, an average of 0.32 μc went through the placenta into each fetus. Damage caused in the infant mouse by the administration of P^{32} to the parent mouse chiefly consisted of primary changes due to the uptake of P^{32} by the former. A dosage of 2.4 μc/g reduced the number of offspring. Growth impediment was noted in the offspring of a mouse to which P^{32} was given in a dosage of over 1.2 μc/g during pregnancy. The administration of P^{32} during the middle period of pregnancy produced more marked growth impediment than when given during the latter period. The gonads of the fetus displayed a very high radiosensitivity and so underwent marked degeneration when P^{32} was given to the parent mouse in a dosage exceeding 1.2 μc/g. With the administration of less than 0.6 μc/g, the infant mice were able to achieve nearly normal pregnancy ending in delivery at full term. With the administration of over 1.2 μc/g, however, the first filial generation did not have parturition till

16 weeks after birth. The maximal dose for the pregnant mouse which did not produce histological changes in the gonads of the baby mouse was 0.3 μc/g for the testis and 0.6 μc/g for the ovary. (Abstr. Japan Med., 1: No. 13, 1961)

4082 INFLUENCE OF X-RAY IRRADIATION UPON THE METABOLISM OF PORPHYRIN BODIES. I. THE QUANTITY OF PORPHYRIN BODIES IN THE TISSUES. T. Sugihara (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 843-54(1960).

Whole-body x irradiation (from 50 to 600 r) was performed in guinea pigs. Generally, porphyrin bodies, especially metalloporphyrin, decreased in the tissues. In the liver and spleen the decreases were distinct within 30 min after irradiation with 400 or 600 r, the minimum value being ca. $\frac{1}{3}-\frac{1}{4}$ of the normal value. In the lung, heart, intestine, muscle, and kidney the decreases were slight. The adrenal gland showed no change. Blood porphyrin decreased. The changes in other tissue porphyrins were slight. Porphyrin bodies in the urine showed an increase though this was not as distinct as the change in the tissues. The degree of changes was related to the irradiation dose, and it was more considerable after a single irradiation than with the fractionated technique. The changes could be ascribed to disturbance of the tissue function by x irradiation. (Abstr. Japan Med., 1: No. 13, 1961)

4083 INFLUENCE OF X-RAY IRRADIATION UPON THE METABOLISM OF PORPHYRIN BODIES. II. THE INFLUENCE OF PRE-IRRADIATIONAL ADMINISTRATION OF AN OXIDATION-REDUCTION AGENT. T. Sugihara (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 855-64(1960).

Several oxidation-reduction agents (GSH, MEA, AET, vitamins B_1, B_2, and C) were administered separately to healthy guinea-pigs and the amount of porphyrin bodies in the tissues was determined. In the case of injection alone, the metalloporphyrin in the liver increased in the early stages, but occasionally its level in the spleen and adrenal gland also increased. In the case of injection followed by x irradiation, the decrease of metalloporphyrin due to the irradiation was considerably inhibited in the early stages, but not in the later stage. Generally the protective effect was well marked on administration of glutathione. There was, however, no apparent difference in effect as between MEA and AET. Vit. B_1 was most effective and the next so was vit. C. (Abstr. Japan Med., 1: No. 13, 1961)

4084 INFLUENCE OF X-RAY IRRADIATION UPON THE METABOLISM OF PORPHYRIN BODIES. III. THE INFLUENCE OF THERAPEUTIC X-IRRADIATION ON PORPHYRIN BODIES IN THE URINE AND BLOOD OF PATIENTS. T. Sugihara (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 865-72(1961).

Porphyrin bodies in the urine and the blood of 16 patients who received fractionated radiotherapy in the non-recurrent period after radical resection of malignant tumors were measured 1, 6, and 24 hours after the 7th and 21st session. In the urine, a slight temporary increase of porphyrin bodies was observed 6 hours after the 7th irradiation. One hour after the 21st irradiation, porphyrin bodies were increased and did not recover even at 24 hours. Excretion of porphyrin bodies in the urine was maximal at 6 hours after irradiation and was distinct when the upper abdomen or the liver was irradiated. The change in blood porphyrin was slight. Patients with severe radiation sickness showed an increased excretion of porphyrin bodies in the urine. (Abstr. Japan Med., 1: No. 13, 1961)

4085 STUDIES OF THE FIELD SIZE FACTOR. [PART] I. K. Tanakawa (Kyoto Prefectural Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 885-96(1960).

In order to ascertain the influence of marginal effects, the skin of the ears of a rabbit and the skin of the thigh of a patient were irradiated through a radiation field of equal field size (2 sq cm) but different marginal shapes, such as round field (marginal ratio 1), rectangular field (m.r. 1.8), and stellate field (m.r. 2.6, 3.7, and 7.2). Little difference in the skin reactions as between the round, rectangular, and stellate (2.6) fields was observed. The stellate form (3.7), though its macroscopical appearance was similar to that of the other fields, showed histologically significant differences. The stellate (7.2) field showed less changes than the other fields, both in the macroscopical and histological picture. From these findings, it was inferred that toxic substances emanating from the irradiated area were so diffusible that the longer the margin of the field was, the more readily did diffusion occur with a given dose to an area. (Abstr. Japan Med., 1: No. 13, 1961)

4086 EFFECT OF OROTIC ACID ON LEUCOPENIA PRODUCED BY X-IRRADIATION AND ANTITUMOROUS AGENTS. I. Motonaga (Takikawa City Hospital, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 897-903(1960).

When orotic acid was given to patients with definite leukopenia following x irradiation or administration of antitumorous agents, improvement was observed. (Abstr. Japan Med., 1: No. 13, 1961)

4087 CHANGES IN RABBIT SERUM PROTEIN FOLLOWING X-RAY IRRADIATION. S. Arai (Hokkaido Univ., Sapporo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 949-56(1960).

The effect of radiation on serum protein fractions was rather unstable after x irradiation with doses smaller than 200 r; however, when doses of x rays up to 1000 r were given, definite changes such as increase of α-globulin and decrease of γ-globulin resulted. (Abstr. Japan Med., 1: No. 13, 1961)

4088 MORTALITY AMONG RADIATION-EXPOSED CHILDREN. A. Tabuchi and C. Miki (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 994-1005(1960).

The death rate among children exposed to the atomic bomb explosion in Hiroshima in utero and after birth was higher than of a control group. As for the causes of death of children exposed in utero the incidence of neoplastic diseases and circulatory diseases was significantly higher than that of the control group. The mortality among these children did not show any definite relation to the degree of exposure. In the children exposed after birth, the radiation effect was recognized from 3 years to 7 years after exposure. The average lifespan was almost the same as that indicated by the death rate in the 1950–1952 (Japanese) corrected life table. The death rate of children exposed after birth was especially high in girls, and it was largely due to leukemia, though the latter was increased also in the control group. (Abstr. Japan Med., 1: No. 13, 1961)

4089 SIGNIFICANCE OF THE ADMINISTRATION OF CYSTINE PREPARATIONS FOR ASSESSMENT OF WHOLE BODY RADIATION HAZARDS. III. CLINICAL STUDY. T. Muroya (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1051-61(1960).

The bone-marrow function, as indicated by changes in the leukocyte count following the administration of cystine preparations, was studied both in patients treated by deep therapy and in x ray workers. The decrease in the peripheral white blood count in the deep therapy patients was not prevented by the administration of cystine preparations, while in the x-ray workers administration of 100 mg induced hypofunction of the bone marrow. Hematologic examination and the bone-marrow function study utilizing cystine preparations are considered to be important for

determining the degree of radiation hazard. (Abstr. Japan Med., 1: No. 13, 1961)

4090 THE WIDAL TEST IN WORKERS EXPOSED TO RADIOACTIVITY. T. Muroya (Kyoto Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1062-6(1960).

The Widal test was performed on x-ray workers, and the result of this test was compared with the finding of leukocytosis after the administration of a cystine preparation. A significant increase in circulating leukocyte count after the ingestion of milk was seen in 66% of healthy adults who did not engage in x-ray work and in 44% of the x-ray workers who had been engaged for 6 to 10 years. Workers engaged for more than 20 years showed no reaction. After administration of the cystine preparation a significant increase in the circulating leukocyte count was observed in 57% of the cases. (Abstr. Japan Med., 1: No. 13, 1961)

4091 STUDIES OF IRON METABOLISM IN THE RAT FOLLOWING X-IRRADIATION (EXPERIMENTAL STUDIES WITH RADIOACTIVE IRON). I. THE KINETICS OF IRON METABOLISM AFTER SINGLE EXPOSURE. M. Maeda and K. Nakanishi (Kyoto Prefectural Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1078-82(1960).

Iron turn-over rates in the plasma and erythrocytes of the rat were studied at 24 hours after whole-body irradiation with doses of 100 and 200 r using Fe^{59}. The iron clearance time of the plasma was prolonged after irradiation, but the plasma turn-over rate/kg body weight/day increased in irradiated rats, due to the elevated plasma iron level. The relative erythrocyte uptake of Fe^{59} was so severely depressed by x irradiation that the erythrocyte iron turn-over rate decreased proportionally as the x-ray doses increased. The Fe^{59} content in the liver 6 days after injection increased in irradiated rats. An exponential relation was generally found between irradiation doses and the changes produced. (Abstr. Japan Med., 1: No. 13, 1961)

4092 EXPERIMENTAL STUDIES ON THE EFFECTS OF X-RAYS ON THE IMMATURE BONE. Y. Kuroda (Jikei Univ., Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1108-31(1960).

Dividing the tibia of 3-week-old mice into 5 parts, the variations of alkaline phosphatase activity, P^{32} uptake, and their pathological changes were examined. When the tibia was damaged severely in parts of the epiphysis and metaphysis with a single x irradiation of 1000 r the recovery was slow. The retardation of bone growth increased with the dose and it was found that the tibia showed a shortening in length following a dose of 1000 r, and with a dose of over 2000 r the increase of the weight was restricted in the irradiated tibia. P^{32} uptake in the tibia decreased exponentially with a dose up to 3000 r, except in parts of the metaphysis. The depression of P^{32} uptake in the tibia produced by fractionated x irradiation was less than that produced by a single x irradiation in the same x-ray dose, and its manifestation varied essentially with the fractionated dose and the time interval. (Abstr. Japan Med., 1: No. 13, 1961)

4093 STUDIES ON THE CHANGES OF THE BLOOD-FORMING ORGANS IN WEANING MICE AFTER X-IRRADIATION. I. Takahashi (National Inst. of Animal Health, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1973-95(1960).

After a single total-body x-irradiation of 600 r erythroblasts, granulocytes, and lymphocytes were markedly damaged and most of the cells disappeared within 24 hr. Hematopoietic tissues became aplastic within 72 hr. The lymphopoietic tissues were damaged more severely in the lymph nodes than in the spleen. Erythroblasts and granulocytes in the bone marrow and in the spleen began to regenerate on the 5th, and the lymphocytes in the spleen and the lymph nodes on the 5th to 7th days after exposure. At the stage of regeneration, the granulocytes multiplied markedly, whereas the erythroblasts did not regenerate in the bone marrow. On the other hand, multiplication of both erythroblasts and granulocytes was observed in the spleen at the same stage. Here the multiplication was more marked in the case of the erythroblasts than in the case of the granulocytes. Some of the erythroblasts showed hyperplasia on the 14th day after the exposure and the degree of multiplication was most marked on the 21st day. These findings continued until the 70th day after the exposure. The lymphopoietic tissues were well regenerated both in the spleen and in the lymph nodes but this regeneration occurred later than in the case of myelopoietic tissues in the bone marrow and in the spleen. Aplasia of the blood-forming organs was observed in cases which died during the early stage, but regeneration was observed in those cases which lived for relatively long periods after the exposure. However, the lymphopoietic and erythropoietic tissues were generally poor after regeneration. These changes were considered to be important causes of death secondary to irradiation. The changes found in the blood-forming organs of weaning mice were essentially the same as those found in adult mice, but the degree of damage to the hematopoietic tissues was more severe than that found in adult mice. In spite of the severe damage, regeneration was prominent in weaning mice. The hyperplasia of erythroblasts in the spleen may accelerate recovery from injury in weaning mice. (auth)

4094 THE EFFECTS OF AET (S,2-AMINOETHYLISOTHIURONIUMBROMIDE) ON THE INDUCTION OF DOMINANT LETHAL MUTATIONS BY X-RAY. Y. Takeda and T. Sugahara (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi, 20: 1996-2000(1960).

One group of male mice (CBA × C3H and its reciprocal F_1 mature mice) was treated with AET 250 mg/kg 30 min before local x-irradiation of 500 r over the testicular region. In another group this region was exposed without AET treatment. After irradiation each male was mated with two virgin females. The females, in which vaginal plugs were present, were taken away and substituted by other virgin females. The pregnant females were killed after 14 days' gestation and examined. The uteri were opened, and the number of living and dead embryos and corpora lutea was determined. Both the AET-treated and untreated males became sterile 4 weeks after irradiation and became fertile again 5 weeks later. The ratios of (number of living embryos/number of embryos implanted) and (number of embryos implanted/number of corpora lutea) were compared in these 2 groups. It was found that the ratios were not significantly different in the 2 groups, while the ratios were very low compared with those of the control group. AET could not protect the induction of dominant lethal mutation in male mice. The reason for the ineffectiveness is considered to be the low concentration of AET in the reproductive cells at the time of irradiation. (auth)

4095 THE ROLE OF TCA SUBSTRATES ON O_2-UPTAKE IN IRRADIATION. H. Sakakibara (Showa Medical Coll., Tokyo) Nippon Igaku Hoshasen Gakkai Zasshi, 20: 2064-72(1960).

TCA substrates added to Naegeli's solution influenced the O_2-uptake of yeast cells when irradiated by x rays. Pyruvate, citrate, and succinate increased the O_2-uptake when added to Naegeli's solution. Pre-treatment with pyruvate and fumarate increased the O_2-uptake compared

with an irradiated control. Pyruvate was inclined to complete the free radical as an easily oxidizable substance comparable with cystine. Fumarate was considered to supply the deficiency induced by x irradiation. (auth)

4096 STUDY ON THE BIOLOGICAL EFFECT OF X-RAY IRRADIATION ON THE HEART. I. THE EFFECT ON THE CARDIAC METABOLISM. N. Kurata (Mie Prefectural Univ., Tsu, Japan). Nippon Junkanki Gakushi, 25: 360-7 (1960).

Coronary sinus catheterization was performed in 13 dogs. Following an irradiation of 4,000 r to the heart, the A-V difference of glucose in the coronary sinus was decreased; pyruvic and lactic acids and creatine were temporarily increased. Following irradiation of 1,000 to 4,000 r to the hearts of 28 rabbits, the glycogen in the heart muscle decreased, while the glucose, pyruvic and lactic acids, creatine and creatinine contents temporarily increased. In irradiated dogs and rabbits, the porphyrin affinity of the heart muscle was diminished. In 6 toads, no change was found in the lactic dehydrogenase activity even after 6925 r irradiation to the heart. The disturbance of glucose metabolism in the irradiated heart muscle appears to be not in the anaerobic processes but in the aerobic phase, especially in the electron transport system in the mitochondria. (auth)

4097 ELECTRON MICROSCOPIC STUDY OF THE INFLUENCES OF X-IRRADIATION ON BONE MARROW CELLS. S. Iwauchi (Nagoya Univ., Japan). Nippon Ketsueki Gakkai Zasshi, 22: 608(1959).

In rats receiving LD_{50} doses of x irradiation, the sensitivity to x rays were generally high in young cells, next in mature normoblasts, then lymphocytes and granulocytes, and low in monocytes and plasmocytes. The sensitivity to x rays of the fine structural cell components was highest in mitochondria followed by microsomes, external nuclear membrane, Golgi bodies, and nucleus. Vacuole formation after x irradiation was observed in the cytoplasm or nuclear membrane or both. In the mitochondria, irregularity of the crista, pyknosis, vacuole formation, deformation and swelling were observed. In the Golgi bodies enlargement of the Golgi field and increase in number of vacuoles were observed. In the nucleus transparency due to nodulation of chromatin or pyknosis was observed. In the nuclei of myelocytes and metamyelocytes, nucleoli with string-shaped irregular boundary membranes appeared. In eosinophils the crystalline inner ends of the eosinophilic granules disappeared. (Abstr. Japan Med., 1: No. 13, 1961)

4098 SOME PROBLEMS OF REGENERATION. V. V. Brunst (Roswell Park Memorial Inst., Buffalo). Quart. Rev. Biol., 36: 178-206(Sept. 1961).

A review is presented on the origin of the regeneration blastema, and particularly the importance of the skin, the skeleton, and other tissues in the process of regeneration. Also considered are reactions of regenerates to irradiation, including the effect of partial irradiation and the regression of regenerates. Especial attention is given to regeneration under abnormal conditions and to abnormal regeneration. The final section is concerned with the problem of stimulation of regeneration and the possibilities of regeneration in mammals. (80 references.) (auth)

4099 DOSAGE DISTRIBUTION IN P^{32} CONTACT IRRADIATION. T. Takei (Nagasaki Univ.). Rinsho Hoshasen, 4: 828-32(1959).

A chart for calculating dosage in P^{32} contact therapy for skin diseases is presented. In irradiation with the P^{32} attachment, the back scattering factor should be considered. The rate of back scattering varied with the mode of attaching the P^{32} to the skin. By just calculating from the chart experimentally obtained, the skin and subcutaneous tissue dose in rad may be calculated clinically for every millimeter from the skin surface. (Abstr. Japan Med., 1: No. 13, 1961)

4100 EFFECTS OF X-IRRADIATION ON TUMOUR CELLS. II. THE EFFECTS OF X-IRRADIATION ON THE ENZYMES IN THE TUMOUR CELLS OF THE MTK-SARCOMA III. H. Numamoto (Tokushima Univ., Japan). Shikoku Igaku Zasshi, 16: No. 1, 45-54(1960).

The effects of x rays on the activities of succinic dehydrogenase and alkaline phosphatase in the cells were studied cytochemically. The activities of the succinic dehydrogenase and alkaline phosphatase in the tumor cells are localized in the mitochondria in the form of many small granules or grains. When dosages of 200, 1000, and 5000 r were given to tumor cells of the MTK-sarcoma III in vivo, the activities of the two enzymes were decreased slightly after high-dose irradiation and the numbers of the granules with the enzyme were increased. These changes disappeared in 3 to 6 hours after irradiation. The destruction of the tumor cells by irradiation was considered to result from the destruction of the enzyme system in the mitochondria of the tumor cells. (Abstr. Japan Med., 1: No. 13, 1961)

4101 A STUDY OF THE PEROXIDASE REACTION OF LEUCOCYTES IN X-RAY WORKERS. T. Yamamoto (Tokushima Univ., Japan). Shikoku Igaku Zasshi, 16: 90 (1960).

In 40 x-ray workers, hyperchromic anemia and leukopenia were generally observed. The peroxidase reaction of the peripheral blood showed values between 2.4 and 6.8 in pH, which is definitely different from the normal findings. Experimentally, also the shortening of the range of peroxidase reaction was estimated in irradiated rabbits. Therefore, the change in the range of the peroxidase reaction may be accepted as an index of radiation injury. (auth)

4102 INVESTIGATIONS ON A BIOLOGICAL RADIATION PROTECTION. XLII. THE EFFECT OF 5-HYDROXYTRYPTAMINE ON RADIOINDUCED MODIFICATIONS OF THE AMINO ACID METABOLISM. Hanns Langendorff, Hans-Joachim Melching, and Christian Streffer (Universität, Freiburg i. B.). Strahlentherapie, 116: 1-14(Sept. 1961). (In German)

The changes of amino acid metabolism, which are caused by irradiation, are normalized by administration of 5-hydroxytryptamine (serotonin) before a sublethal whole body irradiation. The increased excretion of kynurenin, kynurenic acid, anthranilic acid, and xanthurenic acid in the urine decreases, while the decreased excretion of taurine, caused by irradiation, increases. It is believed that the serotonin has a protective effect in those enzyme systems in which the pyridoxal-5-phosphate is active as a co-enzyme. (auth)

4103 RADIOINDUCED MUTATIONS, NATURAL MUTATION OCCURRENCES, AND THE EVOLUTION OF THE ORGANISM. Rosina Zdansky (Universität, Basel, Ger.). Strahlentherapie, 116: 15-24(Sept. 1961). (In German)

Muller's discovery that ionizing rays induce mutations which are no different from the spontaneous changes of the hereditary factors made the study of these usually rare biological occurrences possible. In numerous experiments since 1927 the mutagenic action of the ionizing rays was confirmed. It was also proved that the mutations never lead to a development of new species from the original ones. In the present work it is shown that the protein specificity of the organisms effectively limits the action of the mutation process within the species. This limitation

is valid not only for the present time but, considering the principle of uniformity, also for the biological past. (auth)

4104 RADIATION EFFECTS ON MITOCHONDRIA. K. E. Wohlfarth-Bottermann and L. Schneider (Universität, Bonn). Strahlentherapie, 116: 25-38(Sept. 1961). (In German)

By means of electron-microscopic examinations with the help of the thin-cutting technique, the cytomorphological effect of lethal and compatible x-ray doses on Paramecium caudatum and Paramecium aurelia were analyzed. The destiny of degenerating mitochondria after radiation action in the form of graded examinations can now be carried out continuously by the electron microscope. The influence of compatible doses changes the chondriom quantitatively: a part of the mitochondria are fully demolished, a part of the mitochondria "survived." Morphological references resulted in a disturbance in the fatty acid oxidation of the mitochondria. A light-microscopically described lipophanerosis (structural-loosening) allows itself to be directly proved electron-optically. Electron microscopy reveals itself as the quickest of all known methods so far, i.e., 15 min after radiation with a compatible dose to prove morphological changes of the cytoplasma and the mitochondria. (auth)

4105 INACTIVATION OF NEUROSPORE CONIDIA BY X RADIATION UNDER VARIOUS CONDITIONS. Herbert Miltenburger and Hans Bauer (Kernforschungszentrum, Karlsruhe, Ger.). Strahlentherapie, 116: 57-69(Sept. 1961). (In German)

Conidia of several strains of Neurospora crassa were irradiated with x rays and the radiation induced inactivation of the conidia was determined. It was shown that characteristic dose-effect curves were obtained for each of these strains. No agreement between the mean number of the nuclei pro conidium (of the various strains) and the numbers of targets, which can be extrapolated from the dose-effect curves, could be derived. A protective effect against a radiation-induced inactivation is attained by drying the conidia. Probably this protection effect arises from an extensive elimination of the indirect effects. Through the addition of cysteine to an aqueous suspension of conidia a protection effect against the radiation-induced inactivation is likewise brought about. A similar high protection effect is also attained through addition of broth, on through the introduction of nitrogen. By combining cysteine with broth on with nitrogen a "hyperprotection" effect is observed. (auth)

4106 THE EFFECT OF EXOGENIC AND ENDOGENIC FACTORS ON THE RADIATION REACTION OF THE SKIN. IV. ENZYMATIC INVESTIGATIONS ON THE EFFECTS OF EXTERNA ON THE RADIATION REACTION OF THE SKIN. Karl Heinz Kaercher (Universität, Heidelberg, Ger.). Strahlentherapie, 116: 70-84(Sept. 1961). (In German)

A report is given about the localization of different enzymes in the skin of rabbit before and after the action of ionizing rays by simultaneous local treatment. The mechanism of action is discussed. (auth)

4107 CONTRIBUTION TO THE TESTING OF BIOLOGICAL-MORPHOLOGICAL RADIATION EFFECTS. Herbert Franke and Guenther Pliess (Universität, Hamburg). Strahlentherapie, 116: 85-96(Sept. 1961). (In German)

One hundred seventy-four young adult rats of both sexes received, under conditions of deep therapy, head radiation with single doses between 25 r and 3000 r at the base of the incisors. The histological examination of the base of the mandibular incisors shows shows a big spectrum of morphological radiation reactions in the mesenchymal and epithelial tooth producing tissue, because in the base of the incisor tissue of highly different metabolical state and with different cell functions are concentrated in the smallest space. The base of the incisors of the rats proved to be a useful test organ for examinations with ionizing rays, because the characteristic morphological cell changes in the tooth tissues are dependent on doses and quantitatively reproduceable. (auth)

4108 CONGENITAL MALFORMATIONS INDUCED BY RADIATION. A BRIEF SURVEY OF THE LITERATURE. Erling Hammer-Jacobsen (University Hospital, Copenhagen). Strahlentherapie, 116: 152-8(Sept. 1961). (In English)

On the basis of examples from the literature a short survey is given of congenital malformations induced by irradiation. Previous animal experiments have often been performed with fairly high doses and only very few reports of human cases have been published. Irradiation during the first half of gestation will presumably induce malformations and the incidence is increased on increasing the doses. Most likely no conclusion may be drawn for certain as to threshold doses, the nature of dose effect graphs, or particularly radiosensitive phases. Most often the fetal dose in x-ray examinations of the abdomen is ranging from about 0.5 to about 2 r. A better evaluation of the hazard in connection with such x-ray examinations may be obtained through more animal experiments with doses below 5 r and through a greater number of human investigations. Until the results of such studies are available, it is advisable, whenever possible, to avoid x-ray examination of the abdomen during the first four months of pregnancy. (auth)

4109 ALTERATION OF THE MORPHOLOGY AND METABOLISM OF PARAMECIUM CAUDATUM AFTER X IRRADIATION. Elvira Nickel (Universität, Munster, Ger.). Z. Naturforsch., 16b: 538-43(Aug. 1961). (In German)

The damages occurring after x irradiation to the morphological structure and to the respiration of Paramecium caudatum were investigated. The degree of damage is dependent on the individual dose and on the physiological state of the cells. The principal damage is found in mitochondria and in the cytoplasm. The size of the applied dose was determined with iron and cerium dosimetry. (tr-auth)

Radiation Sickness

4110 (TID-13911) RATE OF RECOVERY FROM RADIATION INJURY AND ITS RELATIONSHIP TO AFTER EXPECTATION OF LIFE IN MICE. Progress Report, January 1, 1961–September 20, 1961 and Third Renewal Proposal, January 1, 1962–December 31, 1962. John B. Storer (Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). Sept. 20, 1961. Contract AT(30-1)-2313. 15p.

A study on the effect of age and previous radiation exposure on the mortality rate, survival under daily radiation exposure, LD_{50}, and rate of recovery from radiation injury was completed. A total of approximately 4000 RF/J female mice were utilized. When mice were irradiated early in life the death rate was higher in the irradiated population than in the control at all time intervals after exposure. The population irradiated with 400 r at 90 days of age appeared to lose about 120 days of life when only causes of death other than leukemia were considered. The minimum induction period for leukemia was not affected by radiation exposure. The LD_{50}-30 days declined linearly with age in both the irradiated and control populations. The mean survival time under exposure to 100 r per day showed a complex decline with age. The rate of recovery

from radiation injury declined linearly with age. The irradiated population showed a uniformly lower repair rate than the control population. These studies are being continued in a population of 6000 BDF_1 hybrids. The effects of sex and strain difference on radioinduced life shortening is being evaluated in 4 inbred and 2 hybrid strains. A search for correlates of life span was initiated utilizing 23 inbred strains. The early time course of injury and recovery in the intestinal tract and marrow is being investigated in an attempt to test certain cellular models of radiation effects. Life table data and measurements of various physiological and morphological parameters are being obtained. (M.C.G.)

4111 (TID-14284) AN IMMUNOGENETIC STUDY OF THE MECHANISMS OF PROTECTION AGAINST RADIATION DEATH BY TREATMENT WITH HEMOPOIETIC TISSUES. Progress Report [for 1961]. Gustave Hoecker (Chile. Universidad, Santiago, Instituto de Biologia "Juan Noe."). Sept. 22, 1961. Contract AT(30-1)-2488. 6p.

The role of individual histocompatibility loci in the protection against radiation death by means of bone marrow grafting was studied. The differences already observed between the "strong" H-2 and the "weak" H-1 and H-3 loci were confirmed. Other findings indicated that gene-determined anti-genicity may vary according to the genetic background into which any particular gene is placed. Work on transplantation antigens confirmed Z as a new H-locus independent of H-1, H-2, and H-3. Studies on the properties of H-antigens were extended. (M.C.G.)

4112 (AD-255797) REMEDY FOR RADIATION SICKNESS. V. Azernikov. Translated from Nauka i Zhizn, No. 1, 61-4(Jan. 1961). 2p. (AID-61-55)

A white, fluffy substance called tsiin was used by Soviet scientists to treat radiation sickness. The substance is a polysaccharide of bacterial origin and was first obtained from the common tea fungus. A single injection of tsiin was given to x irradiated mice and was followed by treatment with antibiotics. The injection reduced the death rate of the experimental mice to almost zero. The difference in mortality rate between mice treated with antibiotics alone and those treated with antibiotics plus a single injection of tsiin was 20%. Tsiin also proved beneficial in the treatment of cancer. However, it appears that tsiin does not attack the cancer cells, but increases the defense of the organism. (P.C.H.)

4113 (JPRS-10645) THE SERUM OF O. O. BOGOMOLETS IN THE PROPHYLAXIS AND THERAPY OF RADIATION SICKNESS. A. A. Gorodetskii (O. O. Horodets'kyy). Translated from Fiziol. Zhur., Akad. Nauk Ukr. R.S.R., 7: 369-70(May-June 1961). 3p.

Results of experiments on rats showed that antireticular cytotoxic serum reduced mortality following the administration of lethal doses of radioactive phosphorus. Best results were obtained when streptomycin was also administered. (C.H.)

4114 (JPRS-10882) CLOSING OF A PENETRATING DEFECT OF THE GASTRIC WALL BY MEANS OF A HOMOTRANSPLANT IN A COMBINED EXPERIMENTAL RADIATION INJURY. N. V. Stankevich. Translated from Zdravookhran. Belorus., No. 8, 30-5(Aug. 1961). 7p.

The possibility of using a homotransplant for the plastic closure of a gastric wall defect in a combined radiation injury was investigated in cats. A single total 208-r x-ray irradiation was used, and the closure was performed during the latent period or at the height of radiation sickness with a preserved muscular aponeurotic homotransplant wrapped in an omental pedicle. The transplant was found to retain its viability and to lead to the regeneration of the mucous membrane. It is concluded that an x-ray injury does not interfere with the accretion of the homotransplant and the regenerative properties of the gastric mucosa. (D.L.C.)

4115 (JPRS-10918) RESULTS OF BONE MARROW ADMINISTRATION IN RADIATION SICKNESS OF ANIMALS. A. T. Sosnovskii (Sosnovskiy), M. A. Kuntsevich, and M. A. Kasperovich. Translated from Zdravookhran. Belorus., 7: No. 8, 35-6(Aug. 1961).

A discussion is given of the observation of the effects of the administration of bone marrow on radiation sickness in dogs and rabbits irradiated at 100 to 1320 r total dose. It was concluded that repeated administrations of bone marrow are essential for obtaining a therapeutic effect in irradiated animals. (B.O.G.)

4116 (JPRS-11013) PROTECTIVE EFFECT OF CERTAIN INHIBITORS OF CHAIN OXIDATION PROCESS IN ACUTE RADIATION SICKNESS. A. A. Gorodetskii (O. A. Gorodetskiy), V. A. Baraboi (Baraboy), and V. P. Chernets'kii (Chernetskiy). Translated from Dopovidi Akad. Nauk Ukr. R.S.R., No. 6, 812-15(1961). 5p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27496.

4117 RADIOPROTECTIVE EFFICACY OF CYSTEAMINE WITH THE MITOTIC INDEX OF RAT BONE MARROW CELLS AS REFERENCE SYSTEM. P. De, A. Bose, and S. Bose (Chittaranjan National Cancer Center, Calcutta). Acta Radiol., 56: 393-8(Nov. 1961). (In English)

The protective efficacy of cysteamine (150 mg/kg body-weight) was tested on rat bone marrow cells in vivo with the mitotic index as the biologic reference system during a period from 5 min to 30 days after 800 r irradiation. Maximum stable protective efficacy (35 to 92% of that of the normal controls) was observed between the 15th and 30th days. (auth)

4118 BLOOD COAGULATION FACTORS IN TOTAL BODY IRRADIATION. Herbert S. Sise, Jacques Gauthier, Robert Becker, and John Bolger (Boston City Hospital, Boston and Tufts Univ., Boston). Blood, 18: 702-9(Dec. 1961).

Investigation of the clotting factors in five humans accidentally exposed to total-body irradiation disclosed no deficiencies. There was no evidence of a circulating anticoagulant in any case. Moderate fibrinolysis was seen in two instances in the same individual but was not evident in the others. At the eleventh day there was uniformly a moderate increase in the levels of fibrinogen. At the twenty-ninth day there was observed an increase in the levels of factors V and VIII coincidental with thrombocytopenia. This change reversed itself with recovery. A similar increase in the levels of factor VIII and less so of factor V was seen in cases of idiopathic thrombocytopenic purpura and secondary thrombocytopenia. An increase in level of factor VIII was observed in patients on oral coumarin anticoagulation. It is concluded that the supernormal levels of factors V and VIII are secondary to lowered thrombin levels in the circulating plasma as a result of the thrombocytopenia and not due directly to the effect of irradiation. (auth)

4119 THE EFFECT OF D.F.P. ON THE ACUTE INTESTINAL RADIATION SYNDROME IN THE RAT. D. A. Willoughby (Strangeways Research Lab., Cambridge, Eng.). Brit. J. Radiol., 34: 807-13(Dec. 1961).

The administration of diisopropylfluorophosphonate either before or up to 24 hours after abdominal irradiation

reduced mortality after 1,050 and 1,334 r. D.F.P. had no effect on irradiation induced leucopenia nor on the later deaths ("bone-marrow death") that occur after whole body irradiation. The effect of D.F.P. treatment on histological changes in the intestine was studied. D.F.P. appears to have an anti-inflammatory action on radiation injury to the intestine. The mode of action of D.F.P. was discussed and it is suggested that this drug might act by preventing the formation of vasoactive polypeptides (kallikrein and kinins). (auth)

4120 A HISTOCHEMICAL INVESTIGATION OF THE CONTENT OF POLYSACCHARIDES IN THE PROCESS OF HEALING OF ACUTE RADIATION SKIN NECROSIS. L. A. Afrikanova (Inst. of Biological Physics, Academy of Sciences, USSR). Doklady Akad. Nauk S.S.S.R., 140: 1181-4 (Oct. 11, 1961). (In Russian)

Third-degree burns were inflicted on the backs of 30 control mice by contacting the mice for one minute with a vessel containing boiling water. Another group of 52 mice were given a dose of 9965 r on a section of the back 2 × 2 cm in area. Various staining reactions on paraffin sections of tissue taken 1 to 60 days after the irradiation were used to determine the changes in content of the acid mucopolysaccharides which were found only in fatty cells, fibrous structures and papillae. The granulated tissue from mice with third-degree burns showed a clear, positive reaction for acid mucopolysaccharides up to 18 days after infliction of the burn. The radiation burn showed the presence of Schick-positive bodies and also of mucopolysaccharides which were not associated with any definite structure. Dystrophy changes were noted in the cells. The reparative processes in the irradiation burns could not be well-defined, and were much slower than the reparative processes in the thermal burns. Normal formation of collagen was not observed up to the end of a 60-day period. (TTT)

4121 INCREASED DAMAGE TO THE TEETH BY DENTAL CARIES INDUCED BY IONIZING RADIATION. Yu. A. Fedorov (Central Scientific Research Inst. for Medical Radiology, Pavlov First Leningrad Medical Inst.). Doklady Akad. Nauk S.S.S.R., 140: 1195-8(Oct. 11, 1961). (In Russian)

A group of rats (60 days old) given a total x-ray dose of 300 r in fractions of 100 r showed caries in 57.6% of all molars compared to an incidence of caries of 66.6% in a group of rats given a total x-ray dose of 600 r in fractions of 200 r, and an incidence of 1.3% in the control group. In another series of experiments the rats were put on a special carbohydrate diet which is used to produce dental caries in experimental animals. The animals were divided into three groups. Group A was fed 0.025 g of calcium glycerophosphate per day. Group B was given water containing 1 mg/l of sodium fluoride. Group C was given no special protection against the onset of dental caries. The three groups of rats were then given a total dose of 300 r in fractions of 100 r. Group C showed dental caries in 75% of all molars, Group B was 65.2% and Group C was 34.3%. The use of calcium glycerophosphate has a protective action on the formation of dental caries. (TTT)

4122 STUDIES ON CHEMICAL PROTECTION OF RADIATION INJURIES. IV. TREATMENT OF RADIATION INJURIES WITH PANTOTHENIC ACID. M. Ozeki, T. Nagashima, I. Yokochi, R. Mori, and S. Kanegai (Kurume Univ., Japan). Kurume Igakkai Zasshi, 23: 948-53(1960).

Injections of pantothenic acid (PaA) (1 mg daily for 14 days) reduced the mortality rate of mice given 600 r to the whole body from 100 to 30%. Decreases in the numbers of leukocytes and erythrocytes from irradiation of 60 r for 10 days (total of 600 r) were inhibited by the use of PaA (5 mg daily 10 days). PaA prevented the atrophy of the spleen of irradiated rats and activated the regeneration more than in the controls. It was concluded that PaA was useful in the treatment of radiation injury. (Abstr. Japan Med., 1: No. 13, 1961)

4123 SOME ASPECTS OF RADIOBIOLOGIC INJURY IN RELATION TO THE MODE OF ADMINISTRATION OF IONISING RADIATIONS. INTRODUCTION. A. Vallebona (Università, Genoa). Minerva nucleare, 5: 231-6(Oct. 1961). (In Italian)

The concepts of external and internal irradiation are defined, and the differences between the two methods are considered from a general standpoint. Attention is given especially to the space and time distribution of the dose. In the case of external irradiation, these depend exclusively on the radiologist; in internal irradiation, they depend on the type of isotope used and on factors connected with the patient's organism. Comparison of the effects of the two methods of irradiation is based on these considerations. From a general standpoint, radiobiologic injury is considered from three points of view: somatic injury, genetic injury, and the leukemogenic or carcinogenic properties of ionizing radiations. The latter factor is discussed in detail. As it will be impossible to consider every aspect of radiobiologic injury, only certain factors will be considered; their discussion will follow a comparative study of the dose administered by means of external as compared with internal irradiation. Obviously, equal or at least comparable doses must be available before any definite conclusion can be reached. The problem of cellular injury will then be considered, especially with regard to changes in permeability; that of injury to the hemopoietic organs will next be discussed, in relation to the effects of external and internal irradiation. Finally, the problems connected with chemical and biological protection and treatment in relation to the different mode of administration of radiations will be considered. (auth)

4124 PROBLEMS CONNECTED WITH CHEMICAL AND BIOLOGICAL PROTECTION WITH VARIOUS TECHNIQUES OF IRRADIATION. L. Oliva (Università, Genoa). Minerva nucleare, 5: 263-73(Oct. 1961). (In Italian)

The various problems regarding protection and treatment of the effects of ionizing radiations are considered and discussed in relation to the technique of administration. In external irradiation, the major problem is the prevention and treatment of radiation sickness. Chemical and biological therapeutic agents are now available with which even striking symptoms can almost always effectively be relieved. Treatment of the acute external radiation syndrome has a limited practical importance. The problem has yet to be solved whether chemical protective substances administered systematically can diminish the radiosensitivity of the locally irradiated circumscribed pathologic condition. For this reason, preference should be accorded to biological substances, some of which have a therapeutic as well as protective action. In internal irradiation, radiation sickness represents a minor problem, inasmuch as the doses usually used for diagnostic or therapeutic purposes rarely determine the onset of the syndrome. Great care should be taken in choosing the protective and therapeutic substances to be used; both the characteristics of the isotope and the mechanism of the substances considered must be taken into consideration in order to avoid any possible interference capable of diminishing the effectiveness of the isotope. The problem of the treatment of accidentally produced acute radiation sickness is more important.

The best experimental results have been obtained with transplants of embryonic liver tissue, bone marrow, splenic pulp, lymph nodes, etc. For clinical purposes, attention is drawn to bone marrow transfusion, which gives the best results although representing a method applicable only in suitably prepared Institutes. In these cases the other chemical and biological substances are not particularly valuable. (auth)

CHEMISTRY

General and Miscellaneous

4125 (AAEC/Trans-7) DETERMINATION OF STABILITY CONSTANTS IN STEPWISE COMPLEX FORMATION. N. P. Komar. Translated by H. J. de Bruin (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales) from Zhur. Anal. Khim., 15: 260-3(1960). 6p.

It has been shown, by studying the possibilities for determining the constants in stepwise complex formation by the interaction of hydrolyzed metal ions and ligands, that in a vast number of cases the direct measurements of metal ion and ligand activities are necessary. The complete formulas for calculation are given and the conditions which allow some simplifications are established. (auth)

4126 (AAEC/Trans-8) THE INTERACTION OF AQUEOUS $Be(NO_3)_2$ SOLUTIONS WITH SOME ORGANIC ACIDS. I. V. Tananaev and E. P. Shcheglova. Translated by H. J. de Bruin (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales) from Zhur. Neorg. Khim., 2: 1365-73(1957). 10p.

A study was made of the interaction between beryllium ions $[Be(NO_3)_2]$ and oxalic, malonic, succinic, lactic, citric, maleic, and salicylic acids by determining the H^+ ion concentration. It was established that the degree of interaction between Be^{2+} ions and organic acids can be arranged in the following series: oxalate = malonate > salicylate > maleate = citrate > tartrate > succinate > lactate. The inability of the Be^{2+} ion to form only slightly dissociated compounds in the reaction with oxalic acid can be used in the determination of aluminum in the presence of beryllium. (auth)

4127 DEHYDRATION OF PRIMARY DODECYL ALCOHOL BY MAGNESIUM SULPHATE. I. Spitsyn, I. E. Mikhailenko, and G. N. Pirogova (Inst. of Physical Chemistry, Academy of Science, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 1090-2(Oct. 11, 1961). (In Russian)

$MgSO_4$ containing normal sulfur and radioactive S^{35} (16.6 and 19.1 mc/g) was used as a catalyst in the dehydration of n-dodecanol. The yield of unsaturated hydrocarbons was determined by bromine titration. The yield of unsaturated hydrocarbons is lower with the use of a radioactive catalyst $MgS^{35}O_4$ as compared with the yield with a non-radioactive catalyst $MgSO_4$. However, it was found that the yield of cyclohexene from the dehydration of cyclohexanol is higher with the use of a radioactive catalyst $MgS^{35}O_4$ than it is with non-radioactive $MgSO_4$. It is concluded that the structure of the alcohol molecule, whose vapors are absorbed on the surface of the catalyst, is important in a heterogeneous-catalytic process where a radioactive catalyst is used. (TTT)

4128 COMPLEX IONS IN FUSED SALTS. F. R. Duke (Ames Lab., Ames, Iowa). p.227-9 of "Advances in the Chemistry of the Coordination Compounds." New York, The Macmillan Company, 1961. (IS-317)

Changes in activity of one salt in the presence of another in fused salt solution were measured by a variety of techniques. The equilibrium constants obtained are constant over considerable ranges of concentration. Formation constants for approximately 16 complex ions and the methods of measurement are tabulated. (P.C.H.)

4129 TRANS-DICHLORODIAMMINEPLATINUM(II). ACID HYDROLYSIS AND THE ISOTOPIC EXCHANGE OF THE CHLORIDE LIGANDS. Don S. Martin, Jr. and Roger J. Adams (Ames Lab., Ames, Iowa). p.579-89 of "Advances in the Chemistry of the Coordination Compounds." New York, The Macmillan Company, 1961. (IS-270)

The isotopic exchange of chloride ligands of trans-$[Pt(NH_3)_2Cl_2]$ and its acid hydrolysis are presented. The rates of isotopic exchange were measured with Cl^{36} tracer only in solutions which were at chemical equilibrium. The exchange rate was found to contain a second-order (chloride-dependent) term, in addition to the expected acid hydrolysis term. At $[Cl^-] = 0.1$ M, the two processes contribute about equally to the exchange. It was also found that k_1 for t-$[Pt(NH_3)_2Cl_2]$ is larger than for any of the other chloroamine complexes. A summary of the acid hydrolysis equilibrium quotients and rate constants for platinum (II) complexes and other data are tabulated. (P.C.H.)

4130 POLAROGRAPHIC STUDIES ON THE REDUCTION OF PERTECHNETATE ION IN AQUEOUS SOLUTIONS. H. H. Miller, M. T. Kelley, and P. F. Thomason (Oak Ridge National Lab., Tenn.). p.716-26 of "Advances in Polarography. Vol. 2." I. S. Longmuir, ed. [New York], Pergamon Press, 1960.

Suitable conditions for the quantitative determination of technetium as pertechnetate are suggested by polarograms of pertechnetate in 0.1 M KCl of pH 10 in phosphate buffer solution of pH 7. Since the i_d vs C relationship in pH 7 buffer is linear over a range of 0.1 to 1.1 ppm, it was used for the determination by the standard addition technique of low concentrations of technetium in solutions of fission products. Elements most likely to be present in solutions that contain technetium are rhenium, ruthenium, and other fission products. Tetraphenylarsonium chloride is also present in certain fission product solutions. Only the tetraphenylarsonium chloride is reduced at a more positive potential than is pertechnetate; therefore, if present, it must be separated before the technetium is determined. (P.C.H.)

Analytical Procedures

4131 (BM-RI-5903) SEMIQUANTITATIVE SPECTROGRAPHIC ANALYSIS OF TUNGSTEN. M. J. Peterson and C. L. Chaney (Bureau of Mines, College Park, Md.). Feb. 1961. 20p.

A spectrographic procedure applicable to the semiquantitative determination of 29 elements in tungsten is presented. The method is designed to give estimates of impurity concentrations up to 500 ppm. Limits of detectability range from 0.3 ppm for the more sensitive elements to 100 ppm for the less sensitive ones. Tungsten metal samples varying in particle size from minus 300 to 30 mesh are excited in the presence of 5% germanium with a direct current arc. Germanium acts to stabilize the arc, minimizes the volatilization of tungsten, and serves as an efficient carrier to sweep impurities from the tungsten into the excitation zone. Curves are presented that show the volatilization behavior of germanium, tungsten, and impurities in tungsten at different concentration levels. Data obtained were used as guides in establishing the method of analysis. It is believed that this spectrographic method should prove helpful in evaluating high-purity tungsten. (P.C.H.)

4132 (CNI-93) DETERMINAZIONE DELLO Sr^{90} E DEL Cs^{137} NELL'ACQUA DI MARE. (Determination of Sr^{90}

and Cs^{137} in Sea-Water). A. Malvicini and L. Vido (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Aug. 1961. 12p.

The method of chemical separation and measurements of Sr^{90} and Cs^{137} in sea water is described. The chemical separation of Sr^{90} was obtained by means of calcium co-precipitation with ammonium oxalate; the Cs^{137} separation was made with sodium cobaltinitrite. The results of the preliminary measurements of some samples collected in the Adriatic and Tyrrheniar sea are reported. These methods are suitable for the treatment of a great volume of water. (auth)

4133 (IA-607) FLAME PHOTOMETRIC DETERMINATION OF CAESIUM IN THE PRESENCE OF STRONTIUM AND CALCIUM. M. Stiller (Israel. Atomic Energy Commission, Tel-Aviv). July 1961. 12p.

The determination of micrograms of cesium in the presence of calcium and strontium using a Beckman DU flame spectrophotometer is described. Both the precision and accuracy are 6.5% for cesium concentrations to 30 ppm and 2.5 to 5% for 40 to 50 ppm. (auth)

4134 (IA-692) DETERMINATION OF DEUTERIUM CONCENTRATION IN HEAVY WATER BY THE REACTION $O^{16}(d,n)F^{17}$ INDUCED BY REACTOR NEUTRONS. S. Amiel and M. Peisach (Israel. Atomic Energy Commission, Tel-Aviv). Oct. 1961. 14p.

Recoiling deuterium nuclei from n-d collisions in heavy water react with oxygen. The 66-sec F^{17} resulting from the reaction $O^{16}(d,n)F^{17}$ can be measured and its activity used as a monitor for the deuterium concentration. In a fission spectrum neutron flux of 10^{12} n/cm^2 sec, one gram of 100% D_2O produces about 14 microcuries F^{17} at saturation. The amount of F^{17} produced is proportional to the deuterium content over a wide range. (auth)

4135 (ORNL-TM-64) NON-DESTRUCTIVE ANALYSIS OF URANIUM IN GRAPHITE FUEL ELEMENTS BY NEUTRON ACTIVATION. L. C. Bate, W. J. Hampton, and G. W. Leddicotte (Oak Ridge National Lab., Tenn.). Nov. 28, 1961. Contract [W-7405-Eng-26]. 7p.

A method is presented for the determination of uranium (as U^{238}) in uranium-loaded graphite fuel elements by a non-destructive, direct radioactivity analysis technique. A 200-channel pulse-height analyzer, equipped with a 3 in. × 3 in. NaI(Tl) crystal, is used to measure the Np^{239} radioactivity of the neutron-irradiated samples. The amount of U^{238} in the test samples is determined quantitatively by comparing the Np^{239} radioactivity induced in each sample with the Np^{239} radioactivity induced into known standards of U^{238} processed under the same conditions as the test samples. The limit of detection for U^{238} in samples of normal uranium composition for this method is about 1.0×10^{-4} μg. (auth)

4136 (PG-Report-58(2nd Ed.)) ANALYTICAL METHOD FOR THE SPECTROGRAPHIC DETERMINATION OF LITHIUM, SODIUM, AND POTASSIUM IN BERYLLIUM FLAKE AND POWDER (CARRIER DISTILLATION TECHNIQUE). (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 10p.

The metal is first converted to the oxide. A portion of the oxide is then mixed with sodium chloride as carrier for the determination of lithium and potassium, and another portion of the oxide is mixed with silver chloride as carrier for the determination of sodium. Both portions of oxide are then spectrographed by the carrier distillation technique. Spectra are evaluated by visual comparison with spectra on a standard plate. (auth)

4137 (PG-Report-263) ANALYTICAL METHOD FOR THE DETERMINATION OF TOTAL URANIUM IN RESIDUES CONTAINING URANIUM INSOLUBLE IN NITRIC ACID. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1961. 16p.

The bulk of the uranium sample is extracted by nitric acid leaching. The uranium is separated chromatographically using a cellulose column and di-ethyl ether/nitric acid mixture as eulant. After removal of the ether, the uranium is precipitated as ammonium diuranate, ignited to uranoso uranic oxide, and weighed. The residue from the nitric acid leach is ignited and a portion fused with potassium bisulfate. After removal of the sulfate, the uranium present is separated by continuous ether extraction and determined absorptiometrically using hydrogen peroxide and sodium carbonate/pyrophosphate reagent. (auth)

4138 (PG-Report-280) ANALYTICAL METHOD FOR THE DETERMINATION OF AMERICIUM-241 AND CURIUM-242 IN THE FEED SOLUTION TO THE PRIMARY SEPARATION PLANT. (United Kingdom Atomic Energy Authority. Production Group, Windscale, Sellafield, England). 1961. 5p.

A portion of the feed solution is mixed with a solution of trioctylphosphine oxide in cyclohexane. Uranium and plutonium(IV) are extracted into the solvent phase. Americium and curium are not extracted and are determined by counting the α-activity of a diluted portion of the aqueous phase. The method is intended for the determination of the contribution by americium and curium to the total α disintegration rate of the feed solution. (auth)

4139 (TID-14000) ANALYTICAL CHEMISTRY OF THE POLYPHOSPHATES. William Rieman, III and Herbert L. Rothbart (Rutgers Univ., New Brunswick, N. J.). Oct. 17, 1961. Contract AT(30-1)-1306. 27p.

Additional data were obtained on the separation of linear polymers from cyclic polymers by precipitation with barium chloride. An unexpected peak was observed in the anion-exchange chromatography of a sodium polyphosphate of $\bar{n}$ (average degree of polymerization) = 6, and the compound represented by this peak was isolated. An end-group titration of this compound by microtechnique proved unequivocally that it is a cyclic phosphate. Although the identification (number of phosphorus atoms per molecule) is not completed, evidence from its position in the elution graph by ion-exchange chromatography and from paper chromatography indicate that it is probable pentametaphosphate, $Na_5P_5O_{15}$, or the boat form of tetrametaphosphate, $Na_4P_4O_{12}$. (P.C.H.)

4140 (Y-1369) DETERMINATION OF THORIUM IN THORIUM METAL. L. M. Steckel (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Aug. 21, 1961. Contract W-7405-eng-26. 14p.

A gravimetric procedure was developed for the determination of the percent thorium in thorium metal. In this modification of the classical oxalate method, special attention was given to precipitation conditions and the precipitate wash solution. The results obtained from the analysis of thirteen samples by this method gave a relative limit of error (0.95) for a single determination of ±0.20%. (auth)

4141 DETERMINATION OF PHOSPHORUS, AT A LEVEL OF PARTS PER MILLION, IN ATOMICALLY PURE URANIUM COMPOUNDS, BY THE METHOD OF ISOTOPE DILUTION. Fausto W. Lima and Laura Tognoli Atalla (Instituto de Energia Atomica, Sao Paulo, Brazil). Anais acad. brasil. cienc., 33: 149-60(1961). (In Spanish)

Application is made of the method of isotopic dilution to

the case of phosphorus analysis when this element is present at the level of parts per million in uranium compounds. The efficiency of the method is checked by analysis of samples of sodium phosphate with known amounts of phosphorus, as well as by analysis of samples of uranium also with known amounts of that element. The experimental method adopted is described. This method is being used to analyze the various batches of atomically pure uranium produced by the Uranium Pilot Plant of the Instituto de Energia Atômica. (auth)

4142 X-RAY SPECTROGRAPHIC DETERMINATION OF THORIUM IN LOW CONCENTRATIONS. J. N. van Niekerk, F. W. E. Strelow, and F. T. Wybenga (Council for Scientific and Industrial Research, Pretoria). Appl. Spectroscopy, 15: 121-4(1961).

A method is described for the rapid determination of small concentrations of thorium. The thorium is first concentrated on a suitable cation exchange resin and then measured directly on an x-ray spectrograph. With the experimental conditions employed it is shown that the extraction of thorium is practically quantitative. Both column and batch extraction methods were investigated, and it is shown that the latter technique is superior both as regards reproducibility and time of analysis. It is further shown how interference effects due to co-adsorbed elements, such as iron, can be overcome by the use of a suitable internal standard. From calibration curves so obtained the thorium concentration in three unknown samples was determined, and the results are compared with those obtained by chemical analysis. (auth)

4143 DETERMINATION OF TRITIUM AND CARBON-14 IN BIOLOGICAL SAMPLES BY RAPID COMBUSTION TECHNIQUES. D. A. Buyske, R. Kelley, J. Florini, S. Gordon, and E. Peets. Atomlight, No. 20, 1-6(Dec. 1961).

Methods for the preparation of any biological sample so that the tritium or carbon-14 content can be measured by liquid scintillation techniques are described. For samples up to 300 mg total dry weight, a method which utilized the Schoniger oxygen flask technique was developed. Samples that do not quantitatively combust by this flask procedure, such as bone, or samples that are heavier than 300 mg dry weight, are combusted in a simple furnace of special design. Illustrations are given of the equipment used, and data are tabulated. (P.C.H.)

4144 RADIOMETRIC DETERMINATION OF SMALL AMOUNTS OF SILVER, BISMUTH, AND MAGNESIUM. Z. Herman (Charles Univ., Prague). Collection Czechoslov. Chem. Communs., 26: 1925-30(Aug. 1961). (In German)

A method for the determination of small amounts of some cations by precipitation with labeled reagents and isolation of the less soluble labeled precipitate on filter paper was reported. In this method determinations were made of silver as the silver iodide in amounts of 1 to 50 μg (with application of beryllium hydroxide as collector) in the presence of up to a thousand fold excess of copper, lead, cadmium, and bismuth, milligram amounts of bismuth by precipitation with iodide and 8-hydroxychinolin, and magnesium in concentrations of 10 to 1000 μg as magnesium ammonium phosphate. (tr-auth)

4145 NEW METHOD OF DETERMINATION OF SODIUM IN VERY HIGH PURITY ALUMINUM. Nguyen-Long-Den, Michel Borot, and Philippe Albert. Compt. rend. 253: 2067-8(Nov. 6, 1961). (In French)

The very small quantities of sodium contained in the molten zone of aluminum were determined by a new method combining the techniques of irradiation by protons and mass spectrometry. (tr-auth)

4146 RADIOACTIVATION ANALYSIS OF STRONTIUM IN RAT BONE ASH (ENGLISH TEXT). Y. Matsumura and R. Fujino (Tokyo Women's Medical Coll.). J. Biochem. (Tokyo), 49: 561-5(1961).

The application of neutron activation analysis to quantitation of stable strontium in bone ash is discussed. The Japan Research Reactor I was utilized as a source of neutron flux of 10^{11} neutrons/sq cm/sec. The results obtained by irradiation for two hours and one week or longer were compared. The radiochemical purification gave a recovery of strontium of about 76 to 86%. Calcium or other coexisting elements were completely removed by the procedure. Strontium content of bone ash of rats fed for three weeks or more with oriental chow MF was within the range of 120-180 μg/g. (auth)

4147 TECHNIQUES AND APPLICATIONS OF RADIOCHROMATOGRAPHY IN THE GASEOUS PHASE. Jean-Pierre Adloff (Centre de Recherches Nucléaires, Strasbourg). J. Chromatog., 6: 373-80(Nov. 1961). (In French)

The radiochromatographic technique is described along with various other detection devices. The radiochromatographic technique distinguishes itself from the ordinary techniques by the detector which records the radioactivity of the solutes which appear at the mouth of the column. For the most part the radioactivity detectors associated in the chromatographic columns, which are described, were conceived in order to respond to the necessity of detecting soft radiations. The radiochromatographic applications in the gaseous phase are tabulated. (P.C.H.)

4148 ANION EXCHANGE BEHAVIOUR OF SOME RARE EARTHS IN DILUTE SULPHURIC ACID SOLUTIONS CONTAINING ETHANOL. R. A. Edge (Univ. of Cape Town). J. Chromatog., 6: 452-4(Nov. 1961). (In English)

Anion exchange characteristics of Y, Nd, Pr, and La in dilute sulfuric acid solutions containing ethanol were investigated. Sorption of these rare earths by amberlite IRA-400 in solutions containing 80% ethanol was measured. As the percentage of the non-aqueous component of the solution was increased, the rare earths showed increased sorption by the resin. (L.N.N.)

General Inorganic and Physical Chemistry

4149 (AF-SAM-61-69) DETERMINATION OF THE DISSOCIATION CONSTANTS OF CHLOROPHENOL RED, PARANITROPHENOL, AND PHENOL RED. Frank A. Brown, Ralph G. Allen, Jr., and Bruce E. Jacobson (School of Aerospace Medicine, Brooks AFB, Tex.). Oct. 1961. 7p.

Experimental determinations of the extinction coefficients, dissociation constants, and ionic strength effects were made with spectrophotometric and potentiometric methods for chlorophenol red (CPR), paranitrophenol (PNP), and phenol red (PR) in aqueous solutions. Data are tabulated and plotted fully. Results for PNP and PR agree with the mass action law, Beer's law, and the Debye-Hückel theory. For CPR, however, the results indicate a difference in hydrogen ion activity as measured by the two methods, and this difference is believed to be due to the influence of the orthochlorine atom on the phenol ring of CPR, which results in hydronium bonding at the oxygen position. (D.L.C.)

4150 (AGC-2121) KINETICS OF ENERGETIC SPECIES AT LOW TEMPERATURES. Final Report [October 1,

1959–September 30, 1961]. Henry S. Judeikis, Max K. Barsh, John M. Flournoy, and Seymour Siegel (Aerojet-General Corp., Azusa, Calif.). Nov. 1961. Contract AF18(603)-110. 39p. (AFOSR-1758)

Research on the stabilization and subsequent chemical reactions of energetic free radicals is summarized. Hydrogen atoms, hydroxyl radicals, and other normally unstable chemical species, produced by ionizing radiation and by electric discharges, were stabilized at low temperatures and were subsequently investigated. The rates of formation and disappearance of some of these radicals were measured over a range of temperatures by means of electron-paramagnetic-resonance techniques. Mechanisms are postulated to explain the observed rate phenomena. (auth)

4151 (BNL-691) SOME METHODS OF PREPARING TETRAVALENT URANIUM SOLUTIONS. H. Katz (Brookhaven National Lab., Upton, N. Y.). Sept. 1961. Contract [AT(30-2)-Gen-16]. 40p.

A number of processes for the preparation of tetravalent uranium solutions, suitable for use as a reductant for plutonium in the partition cycle of solvent extraction processing of irradiated reactor fuels, were investigated. The most attractive process consists of the precipitation of uranyl sulfide by addition of 1.4 M uranyl nitrate to about a 50% excess of 2.5% ammonium sulfide, digestion of the precipitate in the supernate at 40°C for about 90 minutes to decompose uranyl sulfide to UO_2 and sulfur, separation of the solids, and dissolution of the UO_2 in 4 M HNO_3 at 60°C, and finally, separation of the sulfur. A one-hour dissolution under these conditions yields a solution containing 83 grams total U per liter, with 71% in the tetravalent state. (auth)

4152 (CEA-2006) SYNTHESE DU CHOLESTEROL ^{14}C-26. (Synthesis of Cholesterol 26-C^{14}). Michel Herbert and Louis Pichat (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 12p.

The synthesis of 26-C^{14} cholesterol from $C^{14}H_3MgI$ with an over-all yield of 48% is described. The cholesterol is purified by chromatography on alumina. The various intermediates of the synthesis are characterized by thin-layer chromatography. (auth)

4153 (GA-2528(Vol.I)) THEORETICAL STUDY OF OPTICAL PROPERTIES. PHOTON ABSORPTION COEFFICIENTS, OPACITIES, AND EQUATIONS OF STATE OF LIGHT ELEMENTS; INCLUDING THE EFFECT OF LINES. Final Report. John C. Stewart and Kedar D. Pyatt, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 1961. APPENDIX A: THERMODYNAMIC PROPERTIES AND MEAN OPACITIES. 128p. (AFSWC-TR-61-71(Vol.I))

Photon absorption coefficients and mean opacities were calculated for hydrogen, beryllium, carbon, nitrogen, aluminum, and silicon over a temperature range from 1.5 to 34 ev and a density range from about 10^{-1} g/cm^3 downward. Contributions to the absorption coefficient from free-free (inverse-bremsstrahlung), bound-free (photoelectric), and bound-bound (line-absorption) processes are included, as is Compton scattering. Certain thermodynamic properties are also given. An improved recipe for pressure ionization was derived which is approximately valid at nondegenerate densities for any ratio of Debye length to ion-sphere radius. Line absorption was evaluated using recent results from pressure-broadening theory and a representation of line series which is computationally as simple as the statistical method. The results show that lines increase the Rosseland mean opacity by a factor which can be nearly ten and which is insensitive to moderate changes in line widths. The code employed generated ionic energy levels internally by isoelectronic interpolation, and is immediately applicable to any mixture of elements in which no ion has more than 14 bound electrons. The results of the calculations of thermodynamic properties and mean opacities are given in the tables in Appendix A, and the graphs of the monochromatic absorption coefficients are given in Appendix B, which comprises Vols. II and III. (auth)

4154 (GA-2528(Vol.II)) THEORETICAL STUDY OF OPTICAL PROPERTIES. APPENDIX B: MONOCHROMATIC ABSORPTION COEFFICIENTS FOR HYDROGEN, BERYLLIUM, AND CARBON. Final Report. John C. Stewart and Kedar D. Pyatt, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 1961. Contract AF29(601)-2807. 351p. (AFSWC-TR-61-71 (Vol.II))

4155 (GA-2528(Vol.III)) THEORETICAL STUDY OF OPTICAL PROPERTIES. APPENDIX B: MONOCHROMATIC ABSORPTION COEFFICIENTS FOR NITROGEN, ALUMINUM, AND SILICON. Final Report. John C. Stewart and Kedar D. Pyatt, Jr. (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Sept. 1961. Contract AF29(601)-2807. 375p. (AFSWC-TR-61-71 (Vol.III))

4156 (GAT-T-552(Rev.1) REACTIONS OF MOLYBDENUM, TUNGSTEN, AND URANIUM HEXAFLUORIDES WITH NITROGEN COMPOUNDS. [PART] I. NITROUS AND NITRIC OXIDES. P. R. Ogle, J. R. Geichman, and S. S. Trond (Goodyear Atomic Corp., Portsmouth, Ohio). Contract AT-(33-2)-1. 5p.

Nitrosylium hexafluoromolybdate(V) and nitrosylium hexafluorouranate(V) were prepared and characterized. These compounds were prepared by the reaction of nitric oxide with the respective hexafluoride. Nitric oxide did not react with tungsten hexafluoride. Nitrous oxide was found to be unreactive toward molybdenum, tungsten, and uranium hexafluorides. (auth)

4157 (LA-2626) THE KINETICS OF A SYSTEM OF CONSECUTIVE FIRST AND SECOND ORDER REACTIONS IN THE NONSTEADY STATE REGION. T. W. Newton and F. B. Baker (Los Alamos Scientific Lab., N. Mex.). Oct. 1, 1961. Contract W-7405-Eng-36. 15p.

An analog computer was used to obtain 41 particular solutions to the differential equations which result from the mechanism $A \rightleftharpoons B$, $B \rightarrow P$, and $A + B \rightarrow P'$. Values of the four rate constants were chosen such that the concentration of B became relatively large and the usual steady state approximation was inaccurate. Differences between the calculated and the steady state approximate values were tabulated, so that the course of the reaction could be sketched for a variety of values of the rate constants. The results also showed the limit of validity of the steady state approximation for the given mechanism. (auth)

4158 (ORNL-3236) MEASUREMENT OF THE VAPOR PRESSURE OF TBP. A. Faure and W. Davis, Jr. (Oak Ridge National Lab., Tenn.). Dec. 13, 1961. Contract W-7405-eng-26. 15p.

Two methods, the transpiration and direct P^{32} counting methods, were tested for use in measuring the vapor pressure of TBP. With the transpiration technique, measured TBP vapor pressures were sufficiently reproducible, and probably of sufficient accuracy, to warrant improvement of the apparatus and its use in measuring the vapor pressure of TBP over various TBP-diluent-HNO_3-H_2O-$UO_2(NO_3)_2$ solutions. With this method the vapor pressure of TBP

containing 0.2 wt % H_2O was determined to be ~0.8 μ while that of TBP saturated with H_2O, ~6.5 wt % H_2O, was ~0.51 μ. The direct P^{32} counting technique was abandoned because of experimental difficulties. (auth)

4159 (AEC-tr-4884) DEPENDENCE OF THE QUENCHING OF FLUORESCENCE IN SOLUTIONS BY ABSORBING SUBSTANCES ON THE VISCOSITY OF THE SOLVENT. L. A. Kuznetsova and B. Ya. Sveshnikov. Translated by Lydia Venters (Argonne National Lab.) from Optika i Spektroskopiya, 4: 55(1958). 8p.

It is shown that in some cases the fluorescent yield and decay time of solutions that are quenched by certain luminescence-absorbing substances depend on the viscosity of the solvent. The systems studied include 3-aminophthalimide quenched by chrysoidin, fuchsin, or crystal violet, and rhodamine 5G quenched by fuchsin. The solvents used are glycerin, isoamyl alcohol, methanol, and ethanol. (T.F.H.)

4160 (AEC-tr-4897) CALCIUM MELLITATE. Marcel Chaigneau. Translated by L. M. Ferris (Oak Ridge National Lab.) from Compt. rend., 238: 358-60 (1954). 3p.

The preparation and properties of calcium mellitate are given. Addition of a 10% solution of $CaCl_2$ to a solution of ammonium mellitate of the same concentration results in a flocculent white precipitate which, after 24 hours, forms a microcrystalline deposit which is easily separated by filtration and washed with distilled water. The precipitate is calcium mellitate. The compound obtained by this procedure, when dried to constant weight, was in the form of needle-shaped, colorless, micro crystals corresponding to the formula: $Ca_3C_6(CO_2)_6 \cdot 12H_2O$ (found, %: Ca, 17.94; C, 21.3; H, 1.84; Calcd, %: Ca, 17.87; C, 21.43; H, 1.80). The thermal decomposition of the compound is also discussed. (P.C.H.)

4161 (AEC-tr-4898) METHODS FOR PREPARING MELLITIC ACID. M. Chaigneau. Translated by L. M. Ferris (Oak Ridge National Lab.) from Compt. rend., 233: 657-9(1951). 3p.

Six methods for preparing mellitic acid are evaluated. Several experiments on hexamethylbenzene oxidation by fuming nitric acid in a sealed tube, for 3 hours at 120° and then for 6 hours at 160°, were made to test the yield, which averaged 30%. (P.C.H.)

4162 (AEC-tr-4902) APPLICATION OF METHODS INVOLVING THE THERMODYNAMICS OF IRREVERSIBLE PROCESSES TO MASS TRANSFER PHENOMENA IN COLLOIDS. V. D. Ermolenko. Translated by Lydia Venters (Argonne National Lab., Ill.) from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 3: No. 5, 124(1960). 4p.

Using the basic relationships of the Onsager theory, certain regularities in the transfer of heat and mass of substance were obtained. A relationship was established between the thermogradient coefficient and thermodynamic characteristics of the transferred substances. (auth)

4163 (AWRE/Trans/24) STABILITY OF EXPLOSIVES. P. Aubertein. Translated by F. E. Wallwork (Gt. Brit. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Mem. poudres, 41: 111-25(1959). 23p.

The stability of explosives is first of all defined and compared with chemical stability. Then a brief account is given of the development of stability tests and the principal ones are described in detail. A critical survey of the stability of certain explosives stresses the stringency of the conditions imposed and shows that most of the stability tests carried out on explosives are of limited significance since they make no allowance for the properties of the explosives. As stability problems are fundamental they should be given careful study, due account being taken of the repercussions, technical and economic, arising from the conditions laid down. (auth)

4164 (FTD-TT-61-75) THERMODYNAMICS OF ZIRCONIUM AND HAFNIUM CHLORIDES. L. P. Ruzinov and S. F. Belov. Translated from Izvest. Vysshikh Ucheb. Zavendenii, Tsvetnaya Met., No. 6, 104-13(1960). 14p.

The enthalpy, entropy, and heat capacity of the di-, tri-, and tetravalent chlorides of Hf and Zr are determined. By thermodynamic potential means, the possibility of the occurrence of a number of reactions involving the metals and their chlorides is investigated. The thermodynamically possible reactions are studied, with the objective of removing Hf (about 2 mole %) from Zr. It is concluded that a multi-stage process is probably necessary to effect the separation. (T.F.H.)

4165 (NP-tr-822) X-RAY L-SPECTRA OF NIOBIUM IN NIOBIUM DIBORIDE, NITRIDE AND CARBIDE, AND THE NATURE OF THE BOND IN THESE COMPOUNDS. M. I. Korsunskii (Korsunskiy) and Ya. E. (Ye.) Genkin. Translated from Issledovaniya po Zharoproch. Splavam, Akad. Nauk S.S.S.R., Inst. Met. im. A. A. Baikova, 6: 169-73(1960). 8p.

Fluorescent spectra of the L series of niobium in niobium diboride, nitride, and carbide were measured and compared with that for pure niobium. In the measurements, a fast x-ray spectrograph focused by the Johann method was used with excitation by silver L series radiation. The intensity and shape of the $L_{\beta 2}$ and $L_{\gamma 1}$ bands undergo sharp changes on going from niobium to its compounds, while the other bands are not affected significantly. The changes are consistent with the hypothesis that part of the d electrons of niobium leave the atom to enter into the bond in compounds. (D.L.C.)

4166 A METHOD OF OBTAINING CERIUM DIOXIDE. V. I. Belokoskov and G. V. Trofimov. Byull. Izobret., No. 21, 16(1961).

The method is based on settling cerium out of solutions by means of hydrogen peroxide and ammonia, whereupon the cerium deposit is cleaned again by means of dissolving it in nitric acid. In order to obtain a better final product at a lower cost, this method provides for using the nitric acid in an amount sufficient only for the formation of cerium hyponitrate. Then cerium is settled out by using ammonium sulfate, and the cerium hyposulfate thus obtained is transferred into cerium dioxide by known means. (OTS)

4167 THE DIFFUSION OF "ATTACHED" INERT-GAS ACTIVITY. Roger Kelly (Atomic Energy of Canada, Ltd., Ont.). Can. J. Chem., 39: 2411-22(Dec. 1961). (AECL-1362)

It was shown previously that, when an inert gas is irradiated with neutrons in the presence of a powdered solid, between 0.1 and 14% of the induced inert-gas activity is firmly attached to the solid. The manner in which attached inert-gas activity is released at temperatures between 50 and 800°C was studied. Release data were assembled for a number of systems, and it was noted that the release was reproducible and apparently a diffusion phenomenon. Several theoretical treatments based on diffusion theory were then explored. Agreement between theory and observation was poor if a constant activation enthalpy was assumed. Agreement was good, on the other hand, with theory that took account of the damaged condition of the solid, and the

existence of composition anomalies, in the surface region where the inert-gas activity was attached. The damage and composition anomalies were assumed to lead to a spectrum of activation enthalpies and thence to a simplified diffusive motion involving a single rate-controlling jump. The activation-enthalpy spectra for the systems Ar–Nb and Xe–Nb were found to be identical, extending from about 25 to 47 kcal. The spectrum for Xe–Nb_2O_5 extended from about 28 to 76 kcal, and was, in general, similar to the spectra for Xe–SiO_2, Ar–TiO_2, and Xe–TiO_2. (auth)

4168 THE NITRATION OF POWDERED URANIUM BY NITROGEN. Claude Moreau and Joseph Philippot (Centre d'Etudes Nucleaires, Grenoble, France). Compt. rend., 253: 1100-2(Aug. 28, 1961). (In French)

The nitration of powdered uranium by nitrogen was studied by thermogravimetry between 300 and 700°C. The results obtained show the complexity of a powdered solid-gas reaction and chiefly the effect of granulometry. (tr-auth)

4169 AN INVESTIGATION OF INTERACTIONS BETWEEN THORIUM CHLORIDES AND CHLORIDES OF MAGNESIUM, CALCIUM, CERIUM, ALUMINUM, IRON, NIOBIUM, TANTALUM AND OXYCHLORIDE OF NIOBIUM IN MELTS. B. G. Korshunov, V. I. Ionov, T. A. Baklashova, and V. V. Kokorev. Izvest. Vysshikh Ucheb. Zavedenii', Tsvetnaya Met., No. 6, 114-18(1960).

Thermal and tensiometrical analyses were carried out to investigate the interaction of components in the following systems: $ThCl_4$–$MgCl_2$, $ThCl_4$–$CaCl_2$, $ThCl_4$–$CeCl_3$, $ThCl_4$–$AlCl_3$, $ThCl_4$–$FeCl_3$, $ThCl_4$–$NbCl_5$, $ThCl_4$–$TaCl_5$, $ThCl_3$–$FeCl_3$–$NbCl_5$, and $ThCl_4$–$NbOCl_3$. The chlorides were obtained as follows: chloride of thorium by chlorinating a mixture of thorium dioxide and charcoal from sugar with gaseous chlorine at 1000°C; chlorides of aluminum, iron, and tantalum were prepared by chlorination of metals; chlorides of magnesium, calcium, cerium, and oxychloride of niobium by a method previously described. The thermal analysis of the systems was made by the method of fusibility; the curves were recorded on a pyrometer. The $ThCl_4$–$MgCl_2$, $ThCl_4$–$CaCl_2$, and $ThCl_4$–$CeCl_3$ systems have a fusibility diagram of the eutectic type. The eutectics contain 55.0 mole % (82.8 weight %), 46.0 mole % (74.2 weight %) and 60.6 mole % (70.0 weight %) $ThCl_4$ respectively and melt at 610, 560, and 640°C. To confirm data obtained by thermal analysis and to reveal the possibility of separating and refining the chlorides, a tensiometric study of the aforementioned systems based on the measurement of vapor tensions over the systems, which were determined by the flow method was carried out. Chlorine was used as a carrier gas. The absence of a chemical reaction between the components and the difference in the vapor tensions can be used for the separation of chlorides by distillation. The results of the tensiometric investigation are tabulated. (OTS)

4170 THE ACID CATALYZED EXCHANGE OF PHOSPHORUS BONDED HYDROGEN IN AQUEOUS SOLUTIONS OF DIALKYL PHOSPHONATES, STUDIED BY NUCLEAR MAGNETIC RESONANCE. Z. Luz and B. Silver (Weizmann Inst. of Science, Rehovoth, Israel). J. Am. Chem. Soc., 83: 4518-21(Nov. 20, 1961).

The exchange of the phosphorus-bonded hydrogen with deuterium in D_2O was studied for dimethyl-, diethyl- and di-n-propylphosphonate. The kinetics was followed by means of intensity measurements on the proton magnetic resonance spectra of these compounds. The exchange was found to be acid-catalyzed, the rate law for the reaction being: rate = k_H[phosphonate] $[H^+]$ + k_w[phosphonate]. From a comparison of the data obtained with those found for the oxidation of the same compounds, it is suggested that the phosphite form of the dialkyl phosphonates serves as a common intermediate for both the exchange and oxidation reactions. (auth)

4171 THE REACTION OF SODIUM OR POTASSIUM NITRITE WITH RUTHENIUM SALTS. M. Lederer (C.N.R., Rome) and S. K. Shukla. J. Chromatog., 6: 429-36(Nov. 1961). (In English)

Reactions between alkali nitrites and ruthenium salts were studied using paper electrophoresis. Conditions for obtaining a single electrophoretic species are described. (auth)

4172 THE MASS SPECTRUM OF STANNANE. F. E. Saalfeld and H. J. Svec (Ames Lab., Ames, Iowa). J. Inorg. & Nuclear Chem., 18: 98-102(1961). (IS-92)

The mass spectrum of stannane, SnH_4, was studied. Ion fragmentation patterns for both the singly and doubly charged fragments were obtained employing 70 v electrons. From appearance potential data, an estimation of the bond energies of the tin–hydrogen bond in the ion-species SnH_3^+–H, SnH_2^+–H, SnH^+–H, Sn^+–H was made along with ΔH_f for SnH_4. The studies were first made with tin of normal isotopic abundance, and then the results were corroborated with SnH_4 prepared with the separated isotope Sn^{120}. (auth)

4173 A STUDY OF METAL IGNITIONS. II. THE SPONTANEOUS IGNITION OF ZIRCONIUM. F. E. Littman, F. M. Church, and E. M. Kinderman (Stanford Research Inst., Menlo Park, Calif.). J. Less-Common Metals, 3: 379-97(Oct. 1961). (In English)

Spontaneous ignition of zirconium sheets, varying in thickness from 0.010 to 0.250 in., can occur by exposing it rapidly to oxygen under pressure. The ignition limits, in terms of oxygen pressure and concentration, necessary to produce spontaneous ignition, were determined for zirconium and Zircaloy. Ignition resulting from the breaking of ¼ in. bars (in tension) was also investigated. The ignition limits were of the same order of magnitude, that is about 500 psig of oxygen. One of the most interesting aspects of these phenomena is the relative unimportance of the protective oxide layer. Where oxide-free samples required a minimum oxygen pressure of about 300 psig for spontaneous ignition, oxidized samples would be ignited with about 450 psig of oxygen. This suggests that under some conditions an oxide layer does not result in a diffusion-controlled mechanism. (auth)

4174 A STUDY OF 2-HYDROXY-3-NAPHTHOIC ACID DERIVATIVES OF BERYLLIUM. R. P. Agarwal and R. C. Mehrotra (Univ. of Gorakhpur, India). J. Less-Common Metals, 3: 398-406(Oct. 1961). (In English)

Potentiometric, conductometric, and preparative studies of beryllium 2-hydroxy-3-naphthoate systems indicate the formation of two complexes; the 1:1 complex predominates at a pH of about 5.5 and the 1:2 complex in the ionic form at pH 8–9. In aqueous medium the 1:2 complex is precipitated first by the addition of the potassium salt of the acid to a beryllium sulfate solution, which then changes into the 1:1 complex by the addition of one mole of alkali. In 50% alcoholic medium in which complexes are soluble the formation of 1:1 complex is only indicated in acidic solutions. The stability constants in 50% alcohol of the complexes were calculated by Bjerrum's method. For comparison, stability constants for salicylate and sulfosalicylate complexes were also determined under identical conditions. Stability constants k were found to be: $\log k_1$ = 11.98, $\log k_2$ = 7.92; $\log k_1$ = 12.45, $\log k_2$ = 8.50; $\log k_1$ =

11.52, log k_2 = 8.90, respectively for 2-hydroxy-3-naphthoate, salicylate, and sulfo-salicylate complexes. Dissociation constants of the acids were determined in 50% alcohol using a hydrogen electrode. New compounds: $BeC_{11}H_6O_3 \cdot 2\ H_2O$, $H_2Be(C_{11}H_6O_3)_2$, and $K_2Be(C_{11}H_6O_3)_2$ were isolated. (auth)

4175 CRYSTAL STRUCTURE OF $HfBe_2$, $HfBe_{13}$ AND HfBeSi. PARTIAL SYSTEMS $MeBe_2-MeB_2-MeSi_2$ (Me = Zr, Hf). E. Rudy, F. Benesovsky, H. Nowotny, and L. E. Toth. Monatsh. Chem., 92: 692-700(Mar. 1961).

X-ray powder investigations (Cu-K alpha radiation) of pressure-sintered (1200 to 1550°C) Hf-Be specimens and of specimens of the quasibinary systems $HfBe_2$-$HfSi_2$, $ZrBe_2$-$ZrSi_2$, $ZrBe_2$-ZrB_2, $HfBe_2$-HfB_2, $ZrSi_2$-ZrB_2, and $HfSi_2$-HfB_2 were made. Measurement of lattice parameters as influenced by composition was shown by the results. (auth)

4176 THE CRYSTALLINE FIELD PARAMETERS FOR DYSPROSIUM ETHYL SULPHATE. M. J. D. Powell and R. Orbach (Atomic Energy Research Establishment, Harwell, Berks, Eng. and Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 78: 753-8(Nov. 1, 1961).

The four crystalline field parameters of the Dy^{3+} ion in the ethyl sulfate, V_2^0, V_4^0, V_6^0, and V_6^6 are fitted at 4.2 and 58°K to give the known level splittings and g values. It is found that $V_2^0 \sim 125\ cm^{-1}$, $V_4^0 \sim -26\ cm^{-1}$, $V_6^0 \sim -31\ cm^{-1}$, and $V_6^6 \sim 490\ cm^{-1}$, and there exists a slight variation with temperature between 4 and 58°K. These values are, however, in serious disagreement with those obtained by the extrapolation procedure. In particular, V_2^0 is extraordinarily large, in agreement with the previous work on europium ethyl sulfate. An empirical variation of V_n^m with atomic number is given which is in marked contrast to that predicted previously. (auth)

4177 SPIN-LATTICE RELAXATION IN RARE-EARTH SALTS. [PART I]. R. Orbach (Oxford Univ.). Proc. Roy. Soc. (London), A, 264: 458-84(Dec. 5, 1961).

The theory of Elliot and Stevens for rare-earth ion interactions with static ionic surroundings is generalized phenomenologically to represent rare-earth ion interactions with lattice vibrational modes. Evaluation of the spin-lattice interaction is performed in terms of a few constants. One- and two-phonon processes are investigated, and relaxation times for non-Kramers and Kramers salts are computed. (L.N.N.)

4178 SPIN-LATTICE RELAXATION IN RARE-EARTH SALTS. [PART II]. FIELD DEPENDENCE OF THE TWO-PHONON PROCESS. R. Orbach (Oxford Univ.). Proc. Roy. Soc. (London), A, 264: 485-95(Dec. 5, 1961).

The field dependence of the two-phonon process is computed taking into account hyperfine and dipolar fields. The general Gorter-Van Vleck-Hebel-Slichter (G.V.H.S.) formalism is adapted to the rare-earth ions, the previous Hamiltonian techniques being used. It is found that a distinction is necessary between salts with $g_\perp = 0$ and those with $g_\perp \neq 0$. The Brons-Van Vleck formula holds rigorously for the former case, and predicts a relaxation time inversely proportional to $(H^2 + H^2_{hyp.} + H^2_{dip.})/(H^2 + H^2_{hyp.} + \frac{1}{2}H^2_{dip.})$, where $H^2_{hyp.}$ and $H^2_{dip.}$ are the mean square internal hyperfine and dipolar fields, respectively. For the case of $g_\perp \neq 0$, a quite different dependence of relaxation time on field is found by the use of the G.V.H.S. formalism: $1/T_1 \propto (H^2 + \mu H^2_{hyp.} + \frac{1}{2}\mu' H^2_{dip.})/(H^2 + H^2_{hyp.} + \frac{1}{2}H^2_{dip.})$. The terms μ and μ' are computed explicitly for the general case. The Van Vleck effective internal field approach predicts $\mu = 1$, $\mu' = 2$, but in general $\mu < 1$ and μ' may be greater than 2. This arises from the failure of the effective field approximation and from processes neglected by Van Vleck in his treatment; specifically, the effects of spin correlation and of off-diagonal terms in the dipolar Hamiltonian which "help" the oscillating electric field to flip spins. The term μ' will in general decrease with increasing temperature for Raman processes, and be temperature-independent for resonance processes. It should increase with concentration for both. Agreement with experiment is not very good for the case of dysprosium ethyl sulfate ($g_\perp = 0$), but the feature of $\mu' > 2$ for salts with $g_\perp \neq 0$ seems to be characteristic of many magnetic salts. (auth)

4179 RELATIVE INTENSITIES OF TOTALLY SYMMETRICAL VIBRATIONS IN THE RAMAN SPECTRUM OF COMPLETELY DEUTERATED NEOPENTANE IN THE GASEOUS STATE. K. A. Taylor and L. A. Woodward (Oxford Univ.). Proc. Roy. Soc. (London), A, 264: 558-69 (Dec. 5, 1961).

Intensities of the Raman lines of the totally symmetric vibrations of neopentane $C(CH_3)_4$ and deuterated neopentane $C(CD_3)_4$ in the gaseous state are determined photographically relative to the intensity of the ν_1 line of CF_4, used as an internal standard. Assuming the simple Wolkenstein bond-polarizability theory, observed intensities are used to derive complete force-fields for the totally symmetric class of vibrations, and it is found that no such field can account satisfactorily for all the intensities as well as all the frequencies. The simple Wolkenstein theory is thus shown to be inadequate. Knowledge of the intensities of $C(CD_3)_4$ permits for the first time a test of the modification of the theory in which Wolkenstein's assumption, that the polarizability of a bond is not affected by a change of bond orientation, is abandoned. Using an improved 4-parameter field, the modified theory is found to succeed where the simple theory fails. (auth)

4180 TRANSFORMATIONS IN THE Ta–H AND Ta–D SYSTEMS. W. E. Wallace, Per Kofstad, and L. J. Hyvonen. Pure and Appl. Chem., 2: 281-5(1961).

X-ray and neutron diffractions and measurements of electrical resistance, magnetic susceptibility, internal friction, heat capacity, residual entropy and vapor pressure are made of Ta_2H and Ta_2D compounds. Determination of the mechanism of transformation of the solid solution of H in Ta (alpha-phase) to Ta_2H (beta-phase) as a rearrangement of the H atoms, rather than as a magnetic phenomenon is investigated. (auth)

4181 STUDY OF ZIRCONIUM DECOMPOSITION BY SINTERING WITH LIMESTONE. H. E. Kaplan, T. D. Uspenskaya, and T. V. Prianishnikova. Tsvetnye Metally, 34: 59-61(June 1961).

Zr (98-99%) is recovered at 800 to 900°C by preliminary fine grinding and mixing in the ball mill and introducing CaF_2, Na_2SiF_6 salts, and feldspar into the charge. Effect of various salt additions and of granularity of concentrate on recovery percentage is evaluated. (auth)

4182 EFFECTS OF PHOSPHATE AND OTHER ANIONS IN THE POLAROGRAPHY OF URANIUM IN ACID MEDIA. H. E. Zittel, M. T. Kelley, F. L. Conover, and G. R. Wilson (Oak Ridge National Lab., Tenn.). p.530-7 of "Advances in Polarography. Vol. 2." I. S. Longmuir, ed. [New York], Pergamon Press, 1960.

The anionic effect is shown to be very important in uranium polarography and should always be considered in conjunction with the acid effect. It is also shown that the phosphate effect can be controlled by the judicious use of a noncomplexing acid such as perchloric acid. The anions most markedly affecting the i_d of U(VI) are phosphate, sulfate, oxalate, and fluoride. The fluoride effect can be con-

trolled by the addition of a fluoride complexer. In the cases of the others, if the concentration of the ion in question is controlled by keeping it above a minimum concentration (about 0.4 N), in 0.1 N perchloric acid medium, then the effect is essentially constant. Under these conditions, the i_d/C relation for uranium(VI) is linear. (P.C.H.)

4183 PROCESS FOR PRODUCING ALKYL ORTHOPHOSPHORIC ACID EXTRACTANTS. Robert R. Grinstead (to U. S. Atomic Energy Commission). U. S. Patent 3,018,253. Jan. 23, 1962.

A process is given for producing superior alkyl orthophosphoric acid extractants for use in solvent extraction methods to recover and purify various metals such as uranium and vanadium. The process comprises slurrying P_2O_5 in a solvent diluent such as kerosene, benzene, isopropyl ether, and the like. An aliphatic alcohol having from nine to seventeen carbon atoms, and wherein the OH group is situated inward of the terminal carbon atoms, is added to the slurry while the reaction temperature is maintained below 60°C. The alcohol is added in the mole ratio of about 2 to 1, alcohol to P_2O_5. A pyrophosphate reaction product is formed in the slurry–alcohol mixture. Subsequently, the pyrophosphate reaction product is hydrolyzed with dilute mineral acid to produce the desired alkyl orthophosphoric acid extractant. The extractant may then be separated and utilized in metal-recovery, solvent-extraction processes. (AEC)

Radiation Chemistry and Radiochemistry

Refer also to abstract 4387.

4184 (AERE-C/R-1575(1-6)(Suppl.5) SELECTED ABSTRACTS OF ATOMIC ENERGY PROJECT UNCLASSIFIED REPORT LITERATURE IN THE FIELD OF RADIATION CHEMISTRY AND BIBLIOGRAPHY OF THE PUBLISHED LITERATURE—5TH ANNUAL SUPPLEMENT (PAPERS NOTED UP TO DECEMBER 1960). R. W. Clarke, comp. (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). May 1961. 592p.

References (2538) are given to U. S. and foreign reports and published literature published from 1957 through 1961. The references contain information on theory, interpretations, water and aqueous inorganic systems, organic compounds (including polymerization reactions and organic coolants), gaseous systems (excluding organic compounds), solid systems (excluding organic compounds), biochemistry and radiobiology (excluding animal studies, including irradiation of foodstuffs, bacteria, and insects), and miscellaneous (including colloids, corrosion, industrial applications of radiation, irradiation equipment, and general reviews and reports). The report references are arranged alphabetically/serially by report reference number, and the open literature references alphabetically by first named author. Separate author and subject indexes are included. (P.C.H.)

4185 (BNL-695) FISSION FRAGMENT ENERGY DEPOSITION FOR FORMATION OF CHEMICAL PRODUCTS IN TWO PHASE SYSTEMS. John Sears and Meyer Steinberg (Brookhaven National Lab., Upton, N. Y.). Sept. 1961. Contract [AT(30-2)-Gen-16]. 46p.

Deposition efficiencies for slab and spherical fuel elements were derived for quadratic and linear approximations of the true fission fragment stopping power curve. The relative efficiencies for the same two systems were also derived for the cases of linear and quadratic G variation along the fission fragment track. Calculations were made for particular cases with the derived equations and the data were plotted. Several methods of applying these data to different systems of materials are given. Several features noted are the lower efficiency for the quadratic energy loss approximation compared to the linear energy loss approximation, the higher efficiencies due to G value variation, and the increase in efficiency when the range in the process fluid decreases. (auth)

4186 (KFK-62) DIE HERSTELLUNG VON TRÄGERFREIEM PHOSPHOR-32. (The Production of Carrier-Free Phosphorus-32). Dietrich Geithoff (Kernreaktor Bau- und Betriebs-Gesellschaft m.b.H. Institut für Radiochemie, Karlsruhe, Germany). May 1961. 22p.

The formation of P^{32} from (n,γ) and (n,p) reactions is discussed. The methods for the preparation of P^{32} (liquid-liquid extraction, liquid-solid extraction, and distillation) are then reviewed. The selection of a preparation method and the method itself for use at the Karlsruhe Reactor Center are considered in some detail. In the appendix the purification of sulfur and radiochemical purity controls are reviewed. (J.S.R.)

4187 (ORNL-3185) SEPARATION OF TRANSPLUTONIUMS FROM LANTHANIDES BY TERTIARY AMINE EXTRACTION. R. D. Baybarz and Boyd Weaver (Oak Ridge National Lab., Tenn.). Dec. 20, 1961. Contract W-7405-eng-26. 26p.

Elements of the transplutonium group can be separated from those of the lanthanide group by extraction with tertiary amines from concentrated lithium chloride solutions. In laboratory-scale studies single-stage separation factors between the two groups were found to be ≥100. Extraction varied with amine composition and concentration, diluent composition and acidity, and very greatly with salt concentration. Flowsheets were developed for processing transplutoniums to be produced by large-scale neutron irradiation of plutonium. (auth)

4188 (TID-14085) SOLID STATE POLYMERIZATION INITIATED BY GAMMA RADIATION. Progress Report and Proposal for Extension of Contract. Herbert Morawetz, Benjamin Post, Jerome Lando, Nicholas Morosoff, and Stephen Jakabhazy (Brooklyn. Polytechnic Inst. Polymer Research Inst.). Oct. 24, 1961. Contract AT(30-1)-1715. 38p.

Investigations were concentrated on the complete crystal structure determination of some polymerizable crystalline monomers. Work on calcium acrylate dihydrate was completed and is the first polymerizable crystalline vinyl monomer for which the crystal structure is known. Significant progress was also made on the crystal structure of vinyl stearate. A detailed study on the behavior of a crystalline monomer (p-acetamidostyrene), which polymerized spontaneously below its melting point, was also initiated. Important results obtained elsewhere are discussed along with some preliminary work done on fibers produced from a single crystal of trioxane. (P.C.H.)

4189 (UCRL-9903) ON pH EFFECTS IN THE RADIOLYSIS OF AQUO-ORGANIC SYSTEMS. Warren M. Garrison, Boyd M. Weeks, and Sibyl Cole (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-Eng-48. 5p.

In the radiolysis of air-free solutions of organic substances, $G(H_2)$ generally decreases with increasing pH. In the formic acid systems, both $G(H_2)$ and $G(CO_2)$ decrease, and $G(CO_2)$ approaches zero at pH values above 7. Oxalic acid becomes the major product in alkaline solution. Stud-

ies of the systems (I) 0.1 M HCOONa–0.01 M $NaHC^{14}O_3$, (II) 0.1 M $HC^{14}OONa$–0.01 M $NaHCO_3$ show that the oxalate does not arise through reduction of carbonate by H atoms or by solvated electrons. A mechanism for water decomposition involving the hydride ion, H^-, is given. (auth)

4190 ENERGY TRANSMISSION BY ELECTRONIC PROCESSES IN RADIOCHEMICAL REACTIONS OF ORGANIC MOLECULES IN SOLUTION. D. Schulte-Frohlinde (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 419-22(Nov. 1961). (In German)

Various mechanisms for energy transmission are discussed. Certain radiochemical reactions in which energy transmission plays a part are listed. (auth)

4191 ISOLATION OF THE RADIONUCLIDES ^{32}P, ^{35}S, AND ^{131}I FROM IRRADIATED MATERIALS AND PRODUCTION OF COLLOIDAL RADIOGOLD [IN THE KARLSRUHE NUCLEAR RESEARCH CENTER]. D. Geithoff and V. Schneider (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 423-6(Nov. 1961). (In German)

The methods worked out in the Radiochemical Institute of the Nuclear Research Center in Karlsruhe for isolating the radionuclides P^{32}, S^{35}, and I^{131} from irradiated materials, and for producing colloidal radiogold are discussed. The nuclear reactions, chemical separations, and refinement techniques and specifications of the final product are given for each nuclide, as well as indications for protective measures. (auth)

4192 RADIOCHEMICAL DETERMINATION OF RADIONUCLIDES IN WATER. A COMPILATION OF RADIOCHEMICAL ANALYSIS PROCEDURES. H. Schroeder (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 426-33(Nov. 1961).

A compilation is given in tabular form of the methods for selective determination of radionuclides published from 1956 to 1961 in connection with studies of the radioactivity content of water. (auth)

4193 THE PREPARATION OF CARRIER-FREE $Th^{234}(UX^1)$ BY ANION EXCHANGE FROM NITRIC ACID-ALCOHOL MIXED SOLUTION OF URANYL NITRATE. Jun Akaishi (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 34: 1198-9(Aug. 1961). (In English)

The procedure for preparation of carrier-free Th^{234} using an anion exchanger Dowex 1 – X 8 was studied. The UO_2SO_4 was passed thru the column in HNO_3-alcohol. The Th was eluted by HNO_3 or water. An aliquot of the solution was transferred to a glass counting dish and evaporated to dryness. The alpha and beta activities were counted using a gas-flow proportional counter and G-M counter respectively. The Th^{234} yield from 1 gm uranyl nitrate crystal was 4.6×10^5 dpm (Th^{234} + Pa^{234}), and the radiochemical impurities were not observed by alpha and beta energy measurements. (L.N.N.)

4194 RADIATION CHEMISTRY OF CYCLOHEXANE. IV. PRIMARY PRODUCT YIELDS IN THE IRRADIATION OF CYCLOHEXANE. P. J. Dyne and J. A. Stone (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Can. J. Chem., 39: 2381-8(Dec. 1961). (AECL-1356)

The radiolysis of cyclohexane was studied at low total doses and initial G values were determined. Ninety-nine % of the evolved hydrogen was accounted for in hydrogen-deficient products. Cyclohexane, bicyclohexyl, and cyclohexyl-hexene-1 were identified as primary reaction products. Cyclohexyl-cyclohexene was identified as a secondary reaction product. The use of high irradiation doses was shown to lead to decreases in the initial G values of all primary products. (auth)

4195 INERTIAL EFFECTS OF SUBSTITUENTS ON HOT ATOM CAPTURE. Robert Odum and Richard Wolfgang (Yale Univ., New Haven). J. Am. Chem. Soc., 83: 4668-70(Nov. 20, 1961).

A new effect in the hot hydrogen displacement of halogen atoms from halomethanes is reported. Its interpretation involves recognition of factors that appear to control hot atom substitution of heavy atoms and groups. High kinetic energy (hot) hydrogen in the form of tritium recoiling from the $He^3(n,p)T$ nuclear process was allowed to react with the various fluoro-, chloro-, and bromomethanes. While replacement of F by T is quite probable in CH_3F, it is much less so in CH_2F_2, and almost nonexistent in CHF_3 and in CF_4. By contrast replacement of H by T changes much less within this series. Exactly parallel trends appear in the chloro- and bromomethanes. (P.C.H.)

4196 HCl CATALYZED FREE RADICAL FORMATION OF ISOPROPYL CHLORIDE DURING THE RADIOLYSIS AND PHOTOLYSIS OF n-PROPYL CHLORIDE. Herbert L. Benson, Jr. and John E. Willard (Univ. of Wisconsin, Madison). J. Am. Chem. Soc., 83: 4672-4(Nov. 20, 1961).

Evidence that the isomerization of n-C_3H_7Cl to i-C_3H_7Cl, observed in both the Co^{60} radiolysis and the photolysis of degassed liquid n-C_3H_7Cl, occurs by a hydrogen chloride catalyzed free radical chain reaction is reported. The data are in agreement with the mechanism in which an intra-radical shift of a chlorine atom occurs between the alpha and beta carbon atoms of the chloropropyl radical. The G values of the radiolysis products, and the effects of iodine and tritium on the G values are discussed. (P.C.H.)

4197 THE γ-RADIOLYSIS OF METHANOL AND METHANOL SOLUTIONS. J. H. Baxendale and F. W. Mellows (Univ. of Manchester, Eng.). J. Am. Chem. Soc., 83: 4720-6(Dec. 5, 1961).

Product yields from γ-irradiated neutral methanol are given. It is suggested that trace impurities which scavenge a reactive precursor to hydrogen are responsible for the lower yields which were previously reported. The variation of yields with temperature, acid, and various solutes was investigated. The presence of two precursors to hydrogen is indicated by the results and a reasonable interpretation is obtained by assuming that one is the H atom and the other an electron. (auth)

4198 THE REACTIVITY OF HYDROGEN ATOMS IN ALKALINE SOLUTIONS. Joshua Jortner and Joseph Rabani (Hebrew Univ., Jerusalem). J. Am. Chem. Soc., 83: 4868-9(Dec. 5, 1961).

The reactivity of chloroacetic acid with H atoms generated in the gas phase and passed through the solution was investigated. In the pH region 4 to 10, $R(Cl^-)$ was found to be independent of pH and of chloroacetic concentration in the region 0.05 to 0.5 M. Chloride abstraction by H atoms from chloroacetic acid, present at this pH region as CH_2ClCOO^-, is less efficient by a factor of about 10 than the hydrogen abstraction reaction. This indicates that the neutral H atom precursor in irradiated solutions is the solvated electron. In alkaline solution at pH 11 a sharp rise of $R(Cl^-)$ is observed reaching the limiting value of unity at pH 12.5. In the alkaline pH region the reaction yield increases with decreasing scavenger concentration. These experimental results yield a support in favor of the conversion of H atoms to solvated electrons or H_2O^- in alkaline solutions. (P.C.H.)

4199 INVESTIGATIONS ON THE REACTION $Sc^{45}(n,p)Ca^{45}$. III. SEPARATION OF CARRIER-FREE Ca^{45} BY ANION EXCHANGE OF THE SCANDIUM TARGET. R. Muenze and L. Baraniak (Zentralinstitut für Kernphysik,

Rossendorf, Ger.). Kernenergie, 4: 624-8(Aug. 1961). (In German)

After the description of some possibilities for the separation of carrier-free Ca^{45} by distillation, precipitation, and extraction procedures, a new ion exchange process was described. This process is suitable for the separation of large masses of Ca^{45} in carrier-free form. (tr-auth)

4200 ISOLATION OF RADIOACTIVE BISMUTH FROM METALLIC LEAD AND ITS COMPOUNDS. J. R. W. Kerr, D. I. Coomber, and D. T. Lewis (Dept. of Scientific and Industrial Research, London). Nature, 192: 547-8(Nov. 11, 1961).

A method is described for the radiochemical separation and determination of Bi^{210} from Pb^{210}. The separation is achieved in a quantitative manner by the acidic dissolution of 10 to 20 g of the lead material, adding about 10 mg of bismuth as carrier in the form of the nitrate, and precipitating the bismuth with an n-propyl gallate solution in 0.01 normal nitric acid solution at the boiling point. The yellow crystalline precipitate formed consists essentially of the salt, $C_{10}H_9O_5BiH_2O$, and contains 0.4790 g bismuth per g of precipitate dried at 110°C. The Bi^{210} beta activity is counted under a conventional end-window Geiger tube. A table is provided giving the beta activity and alpha activity of various lead samples. (N.W.R.)

4201 ABSORBED BETA RADIATION DOSE IN POLYMETHACRYLIC ACID–METHYL ESTER AND POLYVINYL CHLORIDE. G. Brunner and E. Schoenberg (Institut für Angewandte Radioaktivitat der DAW, Leipzig). Naturwissenschaften, 38: 566-7(1961). (In German)

With the help of a Roesch and Donaldson extrapolation chamber, one of whose electrodes is graphitized polymethacrylic acid–methyl ester and the other is graphitized polyvinyl chloride, the deep dose distribution in both these plastics was investigated for the β emitters $Sr^{90} + Y^{90}$, P^{32}, and Tl^{204}. The absorbed energy was calculated from the Bragg-Gray relationship, and the results are graphed. (J.S.R.)

4202 THE RADIATION CHEMICAL OXIDATION OF SULFUROUS ACID. Richard Schrader and Siegfried Schoenherr (Institut für Anorganische Chemie der Bergakademie, Freiburg, i. B.). Naturwissenschaften, 48: 569(1961). (In German)

The radiation chemical oxidation of sulfurous acid was investigated in aqueous solution. For the preparation of the solution studied, a stream of sulfur dioxide and oxygen at constant composition was led into distilled water, which was irradiated with x rays immediately after the saturation concentration of sulfur dioxide was reached. Samples were taken at intervals of several hours from both the irradiated and unirradiated solutions and the sulfur dioxide was determined iodometrically and the sulfuric acid, after boiling off of the sulfur dioxide, with perchloric acid. The results are graphed. The calculated G value of the purely radiochemical formation of sulfuric is, for approximately 0.7 M sulfurous acid, surprisingly high at 205 ± 12. (J.S.R.)

4203 A THRESHOLD TEMPERATURE IN RADIATION CHEMICAL CRACKING OF PARAFFIN. Guenther O. Schenck, Gabor Foeldiak, and Werner Meder (Max-Planck-Institut für Kohlenforschung, Mülheim-Ruhr, Ger.). Naturwissenschaften, 48: 571-2(1961). (In German)

Irradiation cracking at room temperature causes no chain reaction. In the thermal cracking of paraffin, radical chains are formed, and the fission products cause chain propagation reactions. It would be expected that in the temperature range between irradiation cracking and thermal cracking a different cracking method, in which there would be exclusively radiation chemical initiation followed by radical chains, would arise. The electron irradiation of paraffin showed that the threshold temperature for the transition to this type of reaction was in the region of 300°C. Results were obtained for three dose rates. (J.S.R.)

4204 KINETICS OF EMF ARISING IN POLYMERS IRRADIATED BY X-RAYS. F. F. Kodzhespirov. Nauch. Zapiski, Dnepropetrovskiĭ Gosudarst. Univ., 72: 21-4 (1957).

At the initial instant of irradiation, emf attains instantaneously a maximum and then decreases down to the equilibrium value. The time of establishing the equilibrium value is different for different polymers. At an equal temperature and x-ray intensity, the polymers can be arranged in the order of decreasing time of establishing the stationary value of induced emf as follows: Teflon, polystyrene, polyethylene, plexiglass. The time of equilibrium setting decreases with temperature drop. With discontinuation of irradiation the voltage drops to zero. At a repeated irradiation the maximum is attained only after a preheating of the specimen or holding during 2 days. The maximum magnitude strongly rises with pre-oriented specimens or specimens subjected to the effect of a strong electric field. These phenomena can be explained by assuming the exciton mechanism of internal photoeffect. (OTS)

4205 THE STOPPING POWER FOR ALPHA PARTICLES OF ETHYL ALCOHOL AND CARBON TETRACHLORIDE IN THE LIQUID AND VAPOUR STATES. R. B. J. Palmer (Royal Free Hospital School of Medicine, London). Proc. Phys. Soc. (London), 78: 766-73(Nov. 1, 1961).

Range-energy relations for 8.78 Mev alpha particles in ethyl alcohol and carbon tetrachloride in the liquid and vapor states were determined experimentally using nuclear emulsion and scintillation counting techniques. The range in liquid alcohol was found to be greater than the value previously published. The stopping power for both liquids was found to be different from that of the corresponding vapor, and it is suggested that polarization of the absorbing medium is mainly responsible. (auth)

4206 GRAFTED COPOLYMER COMPOSITIONS. (to S. A. Ethylene-Plastique). British Patent 884,731. Dec. 13, 1961.

Compositions are described which has the mechanical properties of a high molecular weight polyethylene at much lower costs. The compositions comprise a graft polymer of polyethylene and a plasticizer in an amount sufficient to impart to the compositions tensile properties characteristic of a high molecular weight polyethylene. The amount of polyethylene in the graft copolymer is 5 to 95 wt % and may be of a low grade; the monomer in the copolymer is one which yields a homopolymer having a Young's modulus higher than that of a high molecular weight polyethylene. The graft copolymer may be prepared with the aid of ionizing radiation. An alternative way of preparation is described in British Patent 884,732. (D.L.C.)

4207 IMPROVED GRAFTED COPOLYMER COMPOSITIONS. (to S. A. Ethylene Plastique). British Patent 884,732. Dec. 13, 1961.

Compositions which has tensile properties similar to those of high-grade high molecular weight polyethylene may be prepared at lower costs. The method of preparation differs from that described in British Patent 884,731 in that ethylene is radio-grafted onto a polymer base other than polyethylene, rather than grafting a monomer onto polyethylene. The resulting graft copolymer is mixed with

enough plasticizer to impart tensile properties characteristic of high molecular weight polyethylene. (D.L.C.)

Raw Materials and Feed Materials

Refer also to abstract 5042.

4208 (NLCO-800) SUMMARY TECHNICAL REPORT FOR THE PERIOD OCTOBER 1, 1959 TO DECEMBER 31, 1959. John W. Simmons, ed. (National Lead Co. of Ohio, Cincinnati). Jan. 22, 1960. Decl. Aug. 22, 1961. Contract AT(30-1)-1156. 114p.

Feed material evaluations are carried out for 12 uranium concentrates. A pilot-plant investigation is reported of a low-acid metal-nitrate flowsheet, in which it is found that calcined uranyl ammonium phosphate (UAP) cannot be used as a feed material, but that Th contamination and $CaSO_4$ scaling can be controlled. Uranyl nitrate solutions are evaporated in the presence of NH_4OH in order to find the amount of NH_4OH necessary to cause uranic acid precipitation. Laboratory tests show that Nb, Ru, Sb, Ta, Ti, or W present in uranium concentrate feed is apparently completely removed from the UO_3 and UF_4 produced from that feed. Mo concentrations of 1% and V concentrations of 0.175% are shown to be tolerable in the feed, because both can be removed to less than 1 ppm in the final uranyl nitrate product. The condition of "in-use" TBP-kerosene solvents, as to U retention, coalescence time, and degradation product content, is shown to influence plant efficiency. The purity of the extraction system product is improved by the installation of a coalescer-de-entrainer in the "cold" side of the refinery, between the primary extraction columns and the scrub column. A plant-scale test of a continuous pot-denitration process is reported. The effects of precipitation temperature and pH, as well as uranyl nitrate and NH_4OH concentrations, on the product characteristics in the precipitation of ADU from uranyl nitrate–ammonium hydroxide solutions are studied. The effects of the physical properties of Mg used in the bomb reduction of UF_4 to U are studied, including the effects on the yield, slag-metal separation, and preheat time. A valve is developed for the charging of Mg-UF_4 briquettes into heated graphite reactors. Reactor-grade ingots can be made from U produced by this process. The U and slag removal in the thermal shocking of U derbies is studied. The removal of Mg and HF from MgF_2 slag, by removing the Mg by a CaC_2-MgF_2 process and subsequent HF recovery from the residue, is found to be uneconomical. Tool lifetimes in the machining of as-cast and beta heat treated U are compared. Suggestions for lengthening tool lifetimes are presented. The effects of stringers on the surface defects of unclad U fuel elements are shown. An assembly is described that is used in the examination of grain structure of U metal at elevated temperatures. A salt-heating oil-quenching cycle for U slug blanks is investigated. Cu and Sn are determined in bronze samples by electrodeposition at controlled cathode potentials. Sulfate is determined in U materials by automatic photometric titration. (T.F.H.)

4209 (NP-11085) MONTHLY REPORT OF DEVELOPMENT [ON FEED MATERIALS], OCTOBER 1961. (Eldorado Mining and Refining Ltd. Research and Development Div., Ottawa). 21p.

Tests are run to determine a method for precipitating sodium diuranate from a carbonate leach solution. The method tested consists of adding the carbonate pregnant to a caustic solution, and either preceding or following the pregnant with a recycled carbonate slurry. Studies are also made of the aeration of carbonate leach liquors, the solvent extraction of U from carbonate solutions, and the scavenging of carbonate liquor by a sodium ion exchange process. Methods are noted for gravimetric determination of the O/U ratio in UO_2 powders, and for Th^{230} determination in precipitates. In the refining of U, a method for improving solvent extraction processes by slurry clarification is discussed; U batch denitration methods are studied; and the recovery and reprocessing of UO_2 scrap is investigated. The grain sizes in beta-quenched Diorit rods are studied as functions of the quenching variables. Methods for producing U sulfides and oxysulfides are discussed. The effects of pressing variables on the sintered density and structure of UO_2 are outlined. A ceramic grade UO_2 is discussed. The preparation of 26% U^{235}-Al alloy by induction heating is reported. (T.F.H.)

4210 (RMO-4015) RECOVERY OF URANIUM FROM CHATTANOOGA SHALE. Final Report. (Columbia Univ., New York. Mineral Beneficiation Lab.). Sept. 1960. Contract AT(49-1)-621. 256p.

Methods of beneficiating Chattanooga Shales for their uranium content and a preliminary technico-economic evaluation of the process are presented. It was first sought to determine the chemical and physical conditions in the shale which were responsible for the low recoveries experienced in the empirical work, and next how the permeability of the shale to lixiviant liquors affected recovery was determined. Following this, studies were made to determine what pretreatment was necessary in order to maximize this permeability. Simultaneously, an effort was made to determine whether the state of oxidation of the uranium had an effect on recovery. The technico-economic evaluation was limited to the two most promising processes: countercurrent leaching of raw shale with sulfuric acid and oxygen pressure leaching in which leaching and acid production are simultaneously achieved. Mention is also made of a possible third method, high temperature chlorination of shale. The costs of producing uranium from Chattanooga Shale by countercurrent acid leaching or by oxygen pressure leaching are estimated in detail. (P.C.H.)

4211 (JPRS-11292) THE ELECTROREDUCTION OF URANIUM(VI) COMPOUNDS IN CARBONATE SOLUTIONS. Mieczyslaw Perec. Translated from Nukleonika, 6: 357-69(1961). 16p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27616.

4212 CAPILLARY LEACHING OF URANIUM ORES. P. Mouret and P. Potter (Commissariat à l'Énergie Atomique, Saclay, France). Énergie nucléaire, 3: 251-60(July-Aug. 1961). (In French)

Chemical concentration plants all use agitation leaching for uranium ores. It became necessary to study a more economical process, which was capillary leaching in mass. After a review of the laboratory tests which permitted a determination of the suitability of a given ore for this type of leaching, a review of two semi-industrial tests, still uncompleted, on capillary leaching is given. The results were such that two large installations were planned and are under construction. (tr-auth)

4213 IMPROVED PROCESS FOR THE PREPARATION OF URANIUM TETRAFLUORIDE FROM URANIUM DIOXIDE. (to U. S. Atomic Energy Commission). British Patent 884,666. Dec. 13, 1961.

Conversion of UO_3 to UF_4 presents problems in that the reduction of UO_3 to UO_2 usually results in a UO_2 which sinters in the strongly exothermic hydrofluorination re-

action and hence hinders the reaction. A method is given for improving the conversion of UO_2 to UF_4 by reducing the sintering effect and thus obtaining higher production rates and reducing the amount of F_2 required in the conversion of UF_6. The method consists simply of slightly reoxidizing the UO_2 before contacting with HF, perhaps to the extent of ≥1 to 2%. The chief use of this method is in conjunction with UO_2 prepared from UO_3 produced by the calcination of $UO_2(NO_3)_2 \cdot 6H_2O$ at ~500°F in a vigorously agitated continuous calciner. (D.L.C.)

Separation Processes

4214 (AERE-M-944) URANIUM PARTITION COEFFICIENTS AT LOW URANIUM CONCENTRATIONS IN NITRIC ACID-20% T.B.P.-O.K. SYSTEMS. D. G. Holmes, P. J. Alder, and D. R. Maybery (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1961. 7p.

Partition data are presented for low concentrations of U in nitric acid-20% tributyl phosphate-odorless kerosene systems at concentrations of nitric acid between zero and 0.3 N in the aqueous phase. The details of the colorimetric determination of U are included. (C.H.)

4215 (ANL-6342) A PROCESS FOR THE RECOVERY OF URANIUM FROM NUCLEAR FUEL ELEMENTS USING FLUID-BED DRYING AND VOLATILITY TECHNIQUES. N. Levitz, J. Barghusen, E. Carls, and A. A. Jonke (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-eng-38. 105p.

A process scheme for the recovery of uranium from fuel elements has been developed. The scheme combines continuous fluid-bed drying and fluoride volatility techniques after initial dissolution of the fuel element in the appropriate aqueous system, hence the designation ADF, Aqueous Dry Fluorination Process. The application of this process to the recovery of uranium from highly enriched, low uranium-zirconium alloy plate-type fuels is described. In the process, the feed solution is sprayed horizontally through a two-fluid nozzle and is atomized directly in the heated fluidized bed. The spray droplets are dried on the fluidized particles and form a dense coating. Excessive particle growth was limited by the use of air attrition-jets inserted directly in the bed. Aqueous hydrofluoric acid solutions containing 1.2 to 3.6 M zirconium, 0.007 to 0.03 M uranium, and free acid concentrations from 1 to about 10 M were successfully processed in a 6-in.-diameter Inconel fluid-bed spray dryer. Rates equivalent to about 3.1 kg/hr of zirconium were achieved, 160 ml/min with the most concentrated feed solution. Experiments were successfully carried out from 240 to 450°C. A new design for a two-fluid nozzle was developed. Extensive work was done to identify the various zirconium fluoride compounds formed. The granular dryer product was subsequently fluorinated at temperatures to 600°C in fluid beds and to 700°C in static beds to remove the uranium as the volatile hexafluoride. About 90 to 95% uranium removal was consistently achieved near 600°C. The relatively low uranium recovery under these conditions is a disadvantage for the application to zirconium-base fuels. It was found necessary to resort to static beds and higher temperatures to achieve greater removal. Since the fluorine attack on nickel, the material of construction, is prohibitive at temperatures above 600°C, a disposable fluorinator concept for use with static beds is described. Results of corrosion studies are reported. A preliminary chemical flowsheet with a design capacity of 1100 kg of uranium (93% enriched) annually is presented. (auth)

4216 (CF-52-5-117) PILOT PLANT EVALUATION OF URANIUM PRODUCT SILICA GEL TREATMENT. W. B. Watkins (Oak Ridge National Lab., Tenn.). May 14, 1952. Decl. Mar. 1, 1961. Contract [W-7405-eng-26]. 12p.

The results of the pilot plant evaluation of the uranium product silica gel treatment show the process to be highly feasible for reducing the gamma activity of the concentrated solvent extraction uranium product. No significant quantities of fission products other than niobium and zirconium were removed by the bed. The gross gamma decontamination factor (based on ion chamber readings) for the uranium solutions tested ranged from two to thirteen, depending on the relative amounts of niobium and zirconium present in the (EU) solvent extraction uranium product and on the method of treatment. A regenerated silica gel bed was operated with no evidence of activity break through. Regeneration of the gel bed proved successful. Spectrographic analyses of the uranium solution before and after treatment showed no consistent significant increase or decrease in silica or other ionic impurity. Occasional reduction in silica and phosphate was noted, but this was believed to result from filtration rather than adsorption. Silicon content of the product solution from the silica gel bed was below specifications on all tests. Enough data are available to show that a full scale plant unit would be reasonable in size and operation. Two parallel columns (one adsorbing, one regenerating) can handle the output of a plant operating at a 3 metric ton uranium per day rate. (auth)

4217 (DP-624) ANION EXCHANGE IN A LARGE-SCALE AGITATED BED. Vincent P. Caracciolo (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 28p.

An agitated ion exchange column was adapted for use in a large radiochemical separations plant. Tests with nonradioactive solutions showed that ion exchange resin could be charged to and discharged from the column through typical plant piping and without the use of mechanical valves. With the agitator turning, the bed passed solutions containing 400 ppm of finely divided silica whereas a fixed bed became plugged. The pressure drop through the column and the absorption characteristics of an anionic complex of thorium nitrate were compared under agitated, pulsed, and fixed bed conditions. (auth)

4218 (HW-63791(Rev.1)) "CRUD" SCRUBBING WITH A PUREX-TYPE ZEBRA CARTRIDGE. G. L. Richardson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 17, 1961. Contract AT(45-1)-1350. 10p.

To investigate the possibility of crud entrainment limiting decontamination factors in the Purex solvent extraction process, pilot plant tests were made in a glass column containing Zebra scrub and nozzle plate extraction section cartridges. The crud was simulated by dispersion of precipitated MnO_2 in the organic phase, and an interfacial crud was formed when the organic phase was contacted with the aqueous scrub. The results indicate that Zebra dispersion removes the crud from the organic phase, but that talc or bentonite is necessary in order that the crud would be flushed out of the scrub section by the HAS flow. Other possible benefits of the talc are given. (D.L.C.)

4219 (HW-68630) CONTINUOUS SLAG AND CRUCIBLE DISSOLVER. H. T. Blaine (General Electric Co.

Hanford Atomic Products Operation, Richland, Wash.). Feb. 1961. Contract AT(45-1)-1350. 28p.

Continuous dissolution of slag and crucibles offers two advantages: capacity increase over the present batch rate and size reduction to critically safe dimensions. The 5-inch ID by 10-foot high dissolver continuously dissolved simulated slag and crucibles at a rate of 240 kg per day. The throughput rate was limited by the duration of the vigorous consecutive reactions which dissolved the can containing the slag and crucibles, and the fine solids within the can. The slow dissolving crucible chips which settled to an equilibrium heel had no effect on the dissolver capacity. The feed materials peculiar to slag and crucibles significantly influenced the design of the equipment, but caused no problems during the operation of the pilot plant. Corrosion was irregular, with the principal material of construction, AISI 309S Nb stainless steel, showing widely variable corrosion rates. (auth)

4220 (IDO-14563) SERIES ELECTROLYTIC DISSOLVER FOR NUCLEAR FUELS. I. SCOPING STUDIES. M. R. Bomar (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 15, 1961. Contract AT(10-1)-205 24p.

A dissolver design was demonstrated on a laboratory scale for the electrolytic dissolution of nuclear fuels. Simplified electrodes are used which need not touch the fuel pieces, thus avoiding the usual problems of achieving adequate electrical contact between the fuel and the anode basket. Because a series of electrolytic cells are formed along the length of the dissolver, current efficiency is enormously increased; this technique allows for the use of higher voltage and much lower current than is presently considered essential in plant-scale electrolytic dissolution. (auth)

4221 (IDO-14565) THE DISSOLUTION OF IRON AND NICKEL IN DILUTE AQUA REGIA. R. D. Cannon (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 1, 1961. Contract AT(10-1)-205. 22p.

In laboratory studies the dissolution of iron in dilute nitric–hydrochloric acid mixtures shows an apparent reaction order of −0.62 with respect to HCl. No apparent order value for HNO_3 can be determined over the concentration ranges studied. Nickel dissolutions show apparent orders of 1.4 with respect to the HCl and 4.2 for HNO_3. Activation energies determined from 50 to 80°C are not constant, ranging from 10 to 20 kcal per mole for both metals. (auth)

4222 (IDO-14566) CONTAINMENT OF IODINE-131 RELEASED BY THE RALA PROCESS. G. K. Cederberg and D. K. MacQueen (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Oct. 30, 1961. Contract AT(10-1)-205. 27p.

Uncontrolled releases of large amounts of iodine occurred during the early stages of RaLa operation at the Idaho Chemical Processing Plant. A ten-fold reduction in the iodine content of the off-gas was achieved by process modifications, primarily the addition of mercury salts to the acidic process solutions. An additional ten-fold reduction was obtained by installing an activated charcoal adsorption unit in series with the original iodine removal scrubber. The iodine content of particulate entrainment limited the over-all iodine removal efficiency of the revised RaLa off-gas iodine removal system. (auth)

4223 (IS-329) ION-EXCHANGE ELUTION SEQUENCES WITH CHELATING ELUANTS. Dean B. James and J. E. Powell (Ames Lab., Ames, Iowa). May 1960. Contract W-7405-eng-82. 97p.

Ion-exchange elution sequences are developed for some di- and trivalent metal ions. The eluants studied include ethylenediaminetetraacetic acid, citric acid, nitrilotriacetic acid, hydroxyethylethylenediaminetriacetic acid, and diethylenetriamine pentaacetic acid. It is found that the addition of a very large amount of common ion actually decreases the efficiency of the separation. The problem of removing the common ion from the rare earths is studied. The effects of the pH of the eluant and the relative concentrations of 2+ and 3+ ions in the separating mixture are studied. A method is described for removing Th from the heavy rare earths. (T.F.H.)

4224 (KR-11) SEPARATION OF URANIUM, NEPTUNIUM, PLUTONIUM, AND AMERICIUM BY REVERSED-PHASE PARTITION CHROMATOGRAPHY. H. Eschrich (Norway. Institutt for Atomenergi, Kjeller). Nov. 1961. 8p.

Reversed-phase partition chromatography was applied to the separation of U, Np, Pu, and Am using TBP as the stationary phase and nitric acid with and without reducing agents as the mobile phase. The general principle of the separation is described. Representative chromatograms are given for the separation of (Cr), U, Np, Pu, Am, and for the separation of U, Np, and Pu. (auth)

4225 (NAA-SR-Memo-1035) COMPARISON OF COST ESTIMATES FOR THE PROCESSING OF SGR FUELS BY SOLVENT EXTRACTION AND BY HIGH TEMPERATURE METHODS AND A PROPOSAL FOR A HIGH TEMPERATURE PROCESSING EXPERIMENT. D. W. Bareis, J. R. Foltz, W. J. Gardner, D. Janeves, and F. D. Rosen (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 1, 1954. Decl. Sept. 7, 1961. Contract [AT(11-1)-Gen-8]. 64p.

Cost estimates were made for plants to process the fuel from a 1000-Mw SGR by solvent extraction and high-temperature methods. The estimated capital investment costs were $2,500,000 for the solvent extraction method and $900,000 for the high-temperature method. The estimated annual costs were $1,800,000 and $1,100,000, respectively. The fuel cycle used for the comparison involves the removal of plutonium from the spent fuel and the addition of the plutonium to natural uranium for new fuel. The fuel remains in the metallic state throughout the high-temperature process. In the solvent extraction process a final metal reduction step is necessary which adds to the processing costs of the fuel. Thus, in the fuel cycles in which the bulk of the spent fuel would be recycled, the high-temperature method has an even greater economic advantage. Proposals are presented for a pilot plant for processing various fuel alloys by high-temperature methods. The plant would furnish the necessary engineering data for full-scale plant design, for cost analyses, and for choosing the optimum processing method for a particular fuel. It is estimated that a pilot plant could be built in conjunction with the Sodium Reactor Experiment for $500,000 and operated for an annual cost of $600,000. (auth)

4226 (NAS-NS-3104) RAPID RADIOCHEMICAL SEPARATIONS. Yusuru Kusaka and W. Wayne Meinke (Univ. of Michigan, Ann Arbor). 1961. 138p.

"Nuclear Science Series" of the National Research Council. Committee on Nuclear Science.

A monograph is presented reviewing methods of rapid radiochemical separations. The review is given in terms of: general procedures prior to rapid radiochemical separations; types of rapid separation processes, including hot atom and recoil, distillation, solvent extraction, precipita-

tion, ion exchange, isotopic exchange, and electrochemical methods; and practical examples arranged by elements. 273 references. (B.O.G.)

4227 (ORNL-TM-33) CHEMICAL TECHNOLOGY DIVISION, UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, MAY 1961. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Dec. 26, 1961. Contract [W-7405-eng-26]. 56p.

The experimental results on the oxidation of H from a He stream with CuO pellets were very close to the predicted behavior based on the mathematical model. Experimental measurements of uranyl sulfate loading rates on chloride equilibrated resin showed little variation with solution concentrations. A tentative flowsheet was proposed for cost analysis of processing a Pebble Bed Reactor. A U–Zr plate was dissolved in nitrate-free Zirflex solution. An authentic TRIGA prototype was processed in engineering-scale equipment. Three 4-stage leacher model dissolution runs were made, two of which used 8 M HNO_3 and one used 4 M HNO_3. Flooding rates and holdup data were obtained for sieve plate pulse columns under 5% TBP - 1.8 M $Al(NO_3)_3$ flowsheet conditions. A Purex waste calcination run (R-37) was made using sodium and magnesium to reduce sulfate volatility. (auth)

4228 (USNRDL-TR-535) GAS-CHROMATOGRAPHIC SEPARATIONS OF RARE GASES. C. L. Carnahan (Naval Radiological Defense Lab., San Francisco). Nov. 2, 1961. 38p.

A procedure was developed for the separation of the rare gases argon, krypton, and xenon from mixtures containing oxygen and nitrogen by use of gas-chromatographic columns packed with molecular sieve type 5A. Helium was the carrier gas. The method is applicable to mixtures which are considerably enriched in the rare gases. The procedure involves: separation of xenon from oxygen, nitrogen, argon, and krypton on a short column at or above room temperature; separation of krypton from oxygen, nitrogen, and argon on a long column at −20°C; and separation of argon from oxygen on the long column at −50°C. The net reduced retention volumes and heats of adsorption were determined for oxygen, nitrogen, argon, krypton, and xenon on molecular sieves types 4A, 5A, and 13X. Voltage output of the differential thermal conductivity detector was measured as a function of the quantity of gas being measured. It is estimated that the presence of about 6×10^{-11} mole, or 0.1 ppm in 25 cc of sample, can be detected. Quantitative measurements can be made down to about 5×10^{-9} mole, or 10 ppm in 25 cc of sample. (auth)

4229 (JPRS-11256) EXTRACTION OF Ru^{106} IN LIQUID RUN-OFF BY ADSORPTION ON FINE PARTICLED MULTIKLON. G. Sachse and E. Leibnitz. Translated from Chem. Tech. (Berlin), 13: 364-5(June 1961). 6p.

Ru nitrosyl complexes may be separated from solutions by precipitation and adsorption of colloidal $[Ru(NO)](SH)_3$. The separation is facilitated if Multiklon powder, which contains up to ~3% free sulfur, is used for both the precipitation and adsorption processes. A series of experiments was made in which the effects of pH, quantity of adsorbent, agitation time, and temperature on the adsorption process were determined. (D.L.C.)

4230 SOLVENT EXTRACTION OF INORGANIC NITRATES WITH DIPHOSPHONATE ESTER. II. THORIUM AND URANYL NITRATES. Hideo Saisho (Mitsubishi Atomic Power Industries, Inc., Saitama, Japan). Bull. Chem. Soc. Japan, 34: 1254-7(Sept. 1961). (In English)

The solvent extraction behavior of thorium and uranium in the system of TBEDP-kerosene and nitric acid solution is described. Infrared absorption studies were also undertaken to obtain the information on the organic phase containing uranium. Results for both elements in the extraction with TBP from nitric acid are added for comparison. The acid dependence curves for TBEDP and TBP are shown to have considerable resemblance; maximum extractions of uranium(VI) from nitric acid solutions are observed at about 6 M nitric acid concentration in both cases. (P.C.H.)

4231 THE USE OF TRI-n-OCTYLAMINE-CELLULOSE IN CHEMICAL SEPARATIONS. E. Cerrai and C. Testa (C.I.S.E., Milan). J. Chromatog., 6: 443-51(Nov. 1961). (In English)

A method is described for the preparation of tri-n-octylamine-cellulose (TOAC). A column of this substance behaves like an anionic resin column and permits separation of many chemical elements. The following separations are given as examples: Fe–Co–Ni, U–Th–La, U–Th–Zr, La–Zr and Zr–Hf. The exchange capacity was evaluated and found to be three to four times lower than that of the common anionic resins. Advantages are indicated. TOAC was compared with Whatman's diethylaminoethyl-cellulose DEAE, as regards retention of uranium from a very acid solution. (auth)

4232 THE ELECTROCHEMICAL DEPOSITION OF URANIUM AND URANIUM COMPOUNDS FROM AQUEOUS SOLUTIONS AND FROM MELTS. Roland W. Ohse and Ernst Raub (Kernforschungszentrum, Karlsruhe, Ger. and Forschungsinstitut für Edelmetalle and Metallchemie, Schwäbisch Gmünd, Ger.). J. Less-Common Metals, 3: 349-59(Oct. 1961). (In German)

The electrochemical deposition of uranium compounds from aqueous solutions was investigated, and a short review of the previous processes of metallic uranium deposition from salt melts is given. The thermodynamic assumptions for uranium deposition are discussed. X-ray structural investigations, electron diffraction patterns, and photomicrographs show uniform inclusion of uranium compounds, especially uranium oxide and uranium tetrafluoride, in metallic zinc by electrolytic deposition from uranyl–zinc acetate and fluoborate baths. Activity measurements in a methane flow counter showed up to 180 mg U^{238}/cm^2. Colorimetric measurements indicate that these electrolytic deposited layers contain up to 46% uranium by weight. (auth)

4233 RECOVERY URANIUM FROM MATERIAL CONTAINING URANIUM AND MOLYBDENUM. (to General Mills Inc.). British Patent 884,611. Dec. 13, 1961.

In processes for extracting U from its ores using liquid amine extractants, Mo has caused some operating difficulty in that it often precipitates as a complex with the amine in the process and interferes with the efficient separation of the U. A method for circumventing this difficulty is given in which the amine extractant containing the U and Mo is scrubbed with a dilute aqueous solution of H_2O_2 to maintain Mo in the molybdate state. The treated extractant is then stripped by an aqueous NaCl solution. (D.L.C.)

4234 PLUTONIUM RECOVERY PROCESSES. Burt Froment Faris and Harry Kaye Strassel, Jr. British Patent 884,702. Dec. 13, 1961.

Procedures are proposed for improving the decontamination of Pu by the bismuth phosphate carrier precipitate process. The procedures consist of adding mercury ions in one of the steps of the precipitation process in conjunction with addition of cerium ions, manganese ions, or an organic dicarboxylic acid. (D.L.C.)

4235 REMOVAL OF CESIUM BY SORPTION FROM AQUEOUS SOLUTIONS. Lloyd L. Ames (to U. S. Atomic Energy Commission). U. S. Patent 3,017,242. Jan. 16, 1962.

A process is given for selectively removing cesium from acid aqueous solutions containing cesium in microquantities and other cations in macroquantities by absorption on clinoptilolite. The cesium can be eluted from the clinoptilolite with a solution of ammonia, potassium hydroxide, or rubidium hydroxide. (AEC)

4236 METHOD OF REMOVING RADIOACTIVE IODINE FROM GASES. L. Silverman (to U. S. Atomic Energy Commission). U. S. Patent 3,018,159. Jan. 23, 1962.

A method of removing radioactive iodine from a gaseous medium is given in which the gaseous medium is adjusted to a temperature not exceeding 400°C and then passed over a copper fibrous pad having a coating of cupric sulfide deposited thereon. An ionic exchange on the pad results in the formation of cupric iodide and the release of sulfur. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

4237 (CEA-BIB-11) SOURCES ETALONS DE NEUTRONS. Bibliographie No. 11. (Standard Neutron Sources. Bibliography No. 11). J. Desdevises (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 22p.

Seventy-nine abstracts are presented on the methods and processes of neutron source calibration and the preparation and properties of standard sources. The abstracts are arranged chronologically and cover a period from 1936 to 1961. (D.L.C.)

4238 (CEND-136) DEVELOPMENT OF STEAM SEPARATION DEVICES. Final Report. (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 1961. Contract AT(11-1)-795. 105p.

A program for the development of steam separation devices for large integral boiler-superheater reactors is being conducted. The experimental program conducted to establish the most reasonable steam separation arrangement for the NUSU 200-MWe reference design of an integral boiler-superheater reactor is summarized. (auth)

4239 (CERN-61-26) LA SEPARATION DES PARTICULES AU MOYEN DE CHAMPS H. F. (The Separation of Particles by Means of H. F. Fields). M. Geiger, P. Lapostolle, and B. Montague (European Organization for Nuclear Research, Geneva). Sept. 28, 1961. 23p.

Discussion is given on the selection of a h-f separator, the definition and calculations of deviations and separations in h-f electrostatic separators, methods of calculation, and various types of separators utilizing h-f. (P.C.H.)

4240 (GAMD-1124(Rev.)) PRELIMINARY ENGINEERING STUDY FOR THE GENERAL ATOMIC IN-PILE HELIUM COOLED LOOP FACILITY. R. H. Simon and R. A. Stella (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 5, 1960. Contract AT (04-3)-314. 72p.

A study was carried out to establish design criteria and parameters for an irradiation test loop in the General Electric Test Reactor, suitable for testing a fueled prototype in a neutron flux environment comparable to the HTGR reference reactor design. The preliminary design concept of a closed cycle, helium-cooled loop system capable of operating continuously at temperatures up to 1900°F at the exit of the fuel element and pressures to 350 psi is presented. The out-of-pile equipment necessary and its location within the reactor building are discussed. The design of the in-pile tube and the insertion and removal problems are described. Thermal and hydraulic analyses are given. The control and safety systems are discussed. (M.C.G.)

4241 (HW-65722(Rev.)) THE THERMAL HYDRAULICS LABORATORY AT HANFORD. J. M. Batch, K. G. Toyoda, and H. E. Hanthorn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1961. Contract AT(45-1)-1350. 56p.

The unique experimental facilities of Hanford's Thermal Hydraulics Laboratory are described in detail. The laboratory facilities are used to conduct studies of heat transfer and fluid flow phenomena in conjunction with Hanford's programs of reactor engineering and fuels technology. (auth)

4242 (KAPL-2173) A MICROPYCNOMETER FOR MEASURING DENSITIES OF POWDERED MATERIALS. J. R. Fascia and W. V. Johnston (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 30, 1961. Contract W-31-109-Eng-52. 17p.

A vacuum pycnometer was designed and used successfully for determining the densities of powdered materials with volumes in the range of 0.01 cc with a precision of 20.0001 cc. Outstanding features of this pycnometer include a flat, horizontally ground joint, and the absence of trapped air in the pycnometer and mercury. (auth)

4243 (NAA-SR-Memo-5184(Rev.B)) DESIGN OF A LINEAR, INDUCTION, ELECTROMAGNETIC PUMP. E. R. Smith (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1960. Contract [AT(11-1)-Gen-8]. 19p.

A linear induction electromagnetic pump was designed for use as the Hallam Nuclear Power Facility sodium service pumps. The design requirements are 100 gpm at 35 psi pressure rise for 650°F sodium, ambient temperature of 200°F, and gamma radiation fields of 5×10^5 r/hr. (D.L.C.)

4244 (NAA-SR-Memo-6569) EXPERIMENTAL MEASUREMENTS OF THE SUCTION HEAD REQUIRED BY THE HALLAM PROTOTYPE FREE SURFACE SODIUM PUMP. R. W. Atz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 25, 1961. Contract [AT(11-1)-Gen-8]. 11p.

Hydraulic tests were made on the Hallam Prototype Free-Surface Sodium Pump to determine the net positive suction head (NPSH) required at various sodium flow rates. Pump performance data were also collected. The results indicate that an NPSH of 22 ft sodium is required at the design flow rate of 7200 gpm at ~1000°F, agreeing with computed values, and that the pump is designed with a safety margin of slightly over 10%. (D.L.C.)

4245 (NAA-SR-Memo-6583) DESIGN OF DIRECT-CURRENT ELECTROMAGNETIC PUMP. R. S. Baker (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 20, 1961. Contract [AT(11-1)-Gen-8]. 12p.

A d-c conduction pump design is given having a capacity of 2.5 gpm of 78%-K NaK against a head of 0.3 psi, for 1000°F Nak. The pump weighs ~15 pounds, and requires 70 amp at 4 volts. (B.O.G.)

4246 (NYO-2856) MODEL TEST FOR STRESSES AND DEFLECTIONS IN THE N.S. SAVANNAH REACTOR VESSEL MODEL AND ATTACHMENTS. R. E. Vining, Jr. (Franklin Inst. Labs. for Research and Development, Philadelphia). [1961]. Contract AT(30-1)-2129. 175p. (F-A2150)

A $\frac{1}{4}$ scale model of the vessel of the Maritime Pressurized Water Reactor used in the N. S. Savannah is tested to determine the stresses in nozzles, closures, and ligaments, and to determine the rotation of the nozzles under pressure. The stresses are assumed to result from internal pressure, piping reactions on primary nozzles, and flange bolt-up. The stresses are found to be well below the yield point of the material, with the exception of the stress caused by internal pressure on the inner surface of the outlet nozzle. In a 150% hydrostatic overpressure test, permanent deformation occurs in the outlet nozzle, but all other stresses remain elastic. (T.F.H.)

4247 (ORNL-3165) DEVELOPMENT OF RING-JOINT FLANGES FOR USE IN THE HRE-2. J. N. Robinson, M. I. Lundin, and I. Spiewak (Oak Ridge National Lab., Tenn.). Dec. 21, 1961. Contract W-7405-Eng-26. 54p.

Ring-joint flanges were studied in thermal-cycle tests as part of the development work associated with Homogeneous Reactor Experiment No. 2 (HRE-2). The purpose of this study was to provide criteria for design, installation, and operation of joints that would remain leaktight under reactor operating temperatures and pressures. Joints ranging from ½ in., 1500 lb to 4 in., 2500 lb and with various initial bolt loadings were cycled between room temperature and 636°F. It was demonstrated that when joints were made up to HRE-2 standards and specifications, leak rates of less than 0.25×10^{-3} g of water per day per inch of gasket pitch diameter could be routinely attained. Undamaged gaskets could be reinstalled or new gaskets used with equal probability of achieving acceptable leak rates. The system installed in HRE-2 was provided with a high-pressure buffer system to ensure that the small amount of leakage to the cell would be nonradioactive. (auth)

4248 (ORNL-3175) LARGE-SCALE SLURRY-CIRCULATION SYSTEM (300-SM). L. F. Parsly, Jr., H. L. Falkenberry, P. H. Harley, I. M. Miller, and V. L. Kenyon (Oak Ridge National Lab., Tenn.). Dec. 21, 1961. Contract W-7405-eng-26. 73p.

Development activities on the large-scale, high-temperature, thoria slurry facility at ORNL were suspended in July 1960. The latest design philosophy, the status of component development, operational procedures, and limitations of each section of the system are presented. The design of the facility would be adequate for a single-region slurry-reactor experiment or a slurry blanket system with a properly developed blanket flow pattern. The equipment consists of a 330-liter circulating system, including a 32-in.-ID pressure vessel designed for service at 2000 psi and 300°C, a 3000-lb-capacity low-pressure system, and the interconnecting lines. Flow sheets are included and materials of construction and recommended instrumentation are discussed. The first five experimental runs in the system, which were made to determine the feasibility of operating with fertile thoria slurry in the blanket region of Homogeneous Reactor Experiment No. 2, either as-built or after minor modification of the original system are summarized. The first run, a heat exchanger test run made at 1800 psi and 300°C, was considered inconclusive. Repeated plugging was experienced, but this occurred in the connecting lines rather than in the heat exchanger. The next four runs were investigations of the high-pressure blanket system, with the pressure vessel installed, at pressures of 200 to 325 psig and temperatures of 150 to 200°C. Slurry was circulated for over 5000 hr at charge concentrations up to 600 g of Th per liter. Circulation was stopped on more than 100 occasions for periods extending from 1 min to 168 hr; there was no difficulty in restarting circulation and resuspending the slurry. However, it was found that a significant fraction of the slurry was not in active circulation and that regions of locally high concentration existed in the vessel. It was concluded that the HRE-2 blanket vessel design does not suspend slurry adequately and that use of slurry in the reactor cannot be recommended. Five runs made after the original HRE-2 blanket vessel model was replaced with an experimental pressure vessel better adapted for slurry handling are described. In the first four of these runs, thoria–8% urania slurry was circulated for 2850 hr at flows of 95 to 380 gpm, temperatures of 40 to 300°C, and concentrations of 170 to 800 g of Th–U per liter. Under most conditions the slurry was maintained satisfactorily in suspension. However, in two of the runs the slurry tended to form intractable plugs and was therefore considered an unsatisfactory material. After further modification of the system and with an improved slurry charge of 1600°C-fired pure thoria, the last run began as a test of the combined high- and low-pressure systems. This run, which lasted 1962 hr, successfully demonstrated the feasibility of pumping thoria slurries through the complex apparatus required in a slurry core or blanket for a thermal breeder reactor. Slurry with a density of 2.0 to 2.4 was pumped to the high-pressure system, raising the thorium concentration to >950 g/liter each time. Slurry was circulated in the high-pressure system at 1500 psi and at temperatures up to 300°C. (auth)

4249 (ORNL-3187) TITANIUM PUMP LOOP FOR AQUEOUS SOLUTIONS AT HIGH TEMPERATURES. J. M. Baker and S. E. Bolt (Oak Ridge National Lab., Tenn.). Dec. 13, 1961. Contract W-7405-Eng-26. 14p.

A titanium pump loop, designed to circulate aqueous solutions at temperatures and pressures up to 370°C and 3000 psia, was constructed. It is to be used to study the chemical stability of uranyl sulfate fuel solutions of interest to the Fluid Fuels Reactor Program. The total loop volume was minimized so that about 2 liters of solution was sufficient for loop operation. The equipment includes a sampling system to remove solution samples from the loop while operating at elevated temperature and pressure; a hydroclone to separate and remove any solids and/or heavy-phase material formed; and provisions for installation of corrosion test specimens in the main loop stream. All equipment performed satisfactorily at design conditions in tests with water. (auth)

4250 (ORNL-TM-8) DEVELOPMENT OF A PIPE CUT AND SEAL DIE. E. Eugene Wade (Oak Ridge National Lab., Tenn.). Sept. 11, 1961. Contract [W-7405-Eng-26]. 33p.

A die was developed which will cut and seal the severed ends of 1½-in. schedule 80, 347H stainless steel pipe. Some development work was done on dies for use on 1½-in. outside diameter × 0.065 wall tube. Very limited work was done on dies for use on 2½-in. schedule 160 pipe. (auth)

4251 (PAN-241/VI) APPARATUS FOR COUNTING THE NUMBER AND INTEGRAL LENGTH OF MEASURED SEGMENTS. S. Mierzejewski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 3p.

A simple device, used to measure the sum of the lengths of segments viewed under a microscope and to record the number of measured segments, is described. (auth)

4252 (UCRL-6529) SYNTHESIS OF WAVE-FORMING NETWORKS. J. W. LaPatra (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 3, 1961. Contract W-7405-Eng-48. 17p.

Passive networks whose specified wave forms are given as a function of time are discussed. The wave forms may be periodic or a single pulse. Suggestions and techniques are presented which should enable a circuit designer with a basic knowledge of network synthesis procedures to obtain wave-forming networks for a wide variety of cases. (auth)

4253 (UCRL-6576) ONE-AMPERE COAXIAL PHOTODIODE. Alfred L. Greilich (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 1, 1961. Contract W-7405-eng-48. 25p.

A 1-ampere, coaxial phototube was developed. The tube is designed to provide a rugged structure and to match a

100-ohm impedance cable. A linear current of more than 1 ampere was achieved by pulsed operation. The anode is a rectangular, flat metal strip rather than the conventional round rod. Design procedure (particularly the trajectory analysis), fabrication technique, and characteristics achieved are discussed. (auth)

4254 (WADD-TN-61-1) A CERENKOV RADIATOR FOR THE PRODUCTION OF MILLIMETER AND SUBMILLIMETER WAVES. Technical Note 1. Charles E. Enderby (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). Jan. 10, 1961. Contract AF33(616)-7043. 68p.

A method is presented by which millimeter and submillimeter power can be generated and radiated into free space at the watt level. The method uses a combination of electronic and physical optic techniques. The electronic technique involved is the generation of Cherenkov power by passing a bunched megavolt electron beam through a nonresonant isotropic dielectric medium. The optical techniques are used to shape the dielectric to form the desired radiation pattern. One dielectric shape is suggested and analyzed that has produced 0.6 watts of power at a wavelength of 8 millimeters in a fairly sharp pattern. The pattern width was about 6° and the pattern was accurately predicted by the theory. With the same cone, the pattern width becomes sharper at higher frequencies and the power level can be made to stay at about the same level or higher by using a K-band Rebatron instead of the S-band one now being used. (auth)

4255 (JPRS-11075) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION RADIO ENGINEERING SERIES. Translation of Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: No. 2, 127-236(1961). 161p.

Nineteen articles are presented from the journal. Two of the articles have been abstracted separately. The articles not abstracted separately cover such topics as resonant cavities, excitation of dielectric-covered metal cylinders, incoherent and analog signal storage devices, pulse amplifiers, semiconductor junction diodes, coaxial spiral elliptical delay lines, analysis of signals with limited spectra, resistance corrections in wires by stretching methods, waveguides, traveling-wave tubes, AM and FM signal detection, transistor detectors, pulse generators, and reflection klystrons. An article is also included concerning higher technical education in Britain. (T.F.H.)

4256 (JPRS-11075(p.42-56)) ELECTRON BEAM IN A COAXIAL SPIRAL LINE WITH AN ANISOTROPIC MAGNETODIELECTRIC MEDIUM. V. P. Shestopalov, B. V. Kondrat'ev, and V. A. Slyasarskii (Slyasarsky). Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: No. 2, 155-64(1961).

An investigation is made of the propagation of electromagnetic waves in a coaxial spiral line in the presence of an electron beam, in the case that the space between the spiral and the sheath is filled with an anisotropic magnetodielectric medium. The boundary conditions for the spiral are approximated by those for an anisotropically conducting cylinder. The power flux and coupling impedance in the system are also investigated. (auth)

4257 (JPRS-11075(p.107-16)) KINEMATIC THEORY OF FORMING VERY SHORT BUNCHES OF ELECTRONS WITH BUNCHERS OF THE KLYSTRON TYPE. D. A. Yakovlev. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: No. 2, 198-203(1961).

It is shown that when the bunching parameter is greater than 1, a single-cavity buncher of the klystron type produces electron bunches of very short duration. Two-cavity bunchers are only capable of achieving this short duration for certain bunching parameters defined in operation. The angle of capture and the bunching angle are determined for very short bunches formed by single- and two-cavity bunchers. The bunching properties of such bunchers are compared. (auth)

4258 (UCRL-Trans-755(L)) INVESTIGATION OF AN ELECTRON STRIP BEAM GUN. Gunter Bolz. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from NTZ-Nachrtech. Z., 12: 464-6 (1959). 11p. (Includes original, 3p.).

Calculation of the "optimal" electron strip-beam gun was carried out and its construction described. To determine the focusing electrodes there was specified a solution of the potential equation by convergent series. Experimental results are reported. (auth)

4259 A DEVICE FOR ADMINISTERING SOLID AND LIQUID RADIOACTIVE MATERIALS. A. I. Telichenas. Byull. Izobret., No. 21, 31(1960).

The device is a syringe-type and differs from others by the following special feature: in order to administer to a patient only a certain (dosed-out) amount of liquid, or a certain prescribed number of granules of a radioactive material, the piston of this novel device is provided with a stepped-motion limiter. In order to prevent the granules from falling out of the needle, the tip of the needle contains a wire spring. (OTS)

4260 HOT CELLS FACILITY AT CESNEF. A. Facchini and S. Terrani (CESNEF, Milan). Energia nucleare (Milan), 8: 701-6(Nov. 1961). (In Italian)

The hot cells of CESNEF are described. They consist of two general purpose radiochemistry units. The cells are connected by a pneumatic transfer with the reactor and designed to handle 1000 curies of 1 Mev gamma emitting material. (auth)

4261 DESIGN AND BUILDING OF CESNEF. G. Bonicalzi (Istituto di Edilizia del Politecnico, Milan). Energia nucleare (Milan), 8: 707-18(Nov. 1961). (In Italian)

The design of the CESNEF building is described, particularly the reactor room. Some construction details are discussed. (auth)

4262 SOME UNUSUAL OPERATIONS ON PARTS FOR NUCLEAR-POWERED SUBMARINES. Machinery (London), 99: 567-71(Sept. 6, 1961).

Tracer-controlled equipment is mentioned for the precision machining of Al, Ni, Cu-Ni alloys, and other metals used in the fabrication of nuclear submarine components. Operations considered include parts of contour planing, groove cutting, threading, honing, drilling, and milling. (auth)

4263 THE DEVELOPMENT AND APPLICATION OF HIGH EFFICIENCY FILTERS IN THE NUCLEAR INDUSTRY IN ENGLAND. Kenneth D. Mulcaster. Staub, 21: 302-6(July 1, 1961).

The requirements of high efficiency filters in the nuclear industries are explained, followed by a survey on the development of high efficiency filters during the past 10 years in England. Applications of high efficiency filters are described for use in nuclear industry, mechanical industry, medical research laboratories, and for air conditioned plants. (Public Health Eng. Abstr., 41: No. 11, 1961).

4264 AUTOMATISCHES AUSWERTUNGSGERÄT FÜR KERNSPUR-EMULSIONEN. (Automatic Evaluation Apparatus for Nuclear Emulsions). Peter Koeppe. Thesis, Berlin, Technische Universität, 1961. 86p.

General properties of nuclear emulsions are discussed. Apparatus was developed for registering and scanning tracks in nuclear emulsions. Characteristics of the apparatus and results of experiments with it are discussed. Pictures and diagrams are included. (M.C.G.)

4265 IMPROVEMENTS IN OR RELATING TO MEASURING DEVICES. Charles Alan Mann (to United Kingdom Atomic Energy Authority). British Patent 884,272. Dec. 13, 1961.

An electrical condenser system is designed for measuring the separation of opposed surfaces in close proximity, e.g., parallel plates forming the fissile structure of a reactor fuel element. The system comprises a metal base plate, a fixed condenser plate next to the base plate, and a movable condenser plate spring-loaded from the base plate. In operation, the device is inserted between the surfaces and the capacity is measured as a function of the separation. (D.L.C.)

4266 MASS SPECTROMETRY. L. Friedman (to U. S. Atomic Energy Commission). U. S. Patent 3,016,459. Jan. 9, 1962.

A method is described for operating a mass spectrometer to improve its resolution qualities and to extend its period of use substantially between cleanings. In this method, a small amount of a beta emitting gas such as hydrogen titride or carbon-14 methane is added to the sample being supplied to the spectrometer for investigation. The additive establishes leakage paths on the surface of the non-conducting film accumulating within the vacuum chamber of the spectrometer, thereby reducing the effect of an accumulated static charge on the electrostatic and magnetic fields established within the instrument. (AEC)

4267 PHASE DIFFERENTIAL INDICATING CIRCUIT. Frederick A. Kirsten (to U. S. Atomic Energy Commission). U. S. Patent 3,016,475. Jan. 9, 1962.

An electronic circuit for totalizing the net phase difference between two alternating current signals is designed which responds to both increasing and decreasing phase changes. A phase comparator provides an output pulse for each 360° of phase difference occurring, there being a negative pulse for phase shift in one direction and a positive pulse for a phase shift in the opposite direction. A counting circuit utilizing glow discharge tubes receives the negative and positive pulses at a single input terminal and provides a running net total, pulses of one polarity being added and pulses of the opposite polarity being subtracted. The glow discharge tubes may be decaded to increase the total count capacity. (AEC)

4268 CONNECTOR. D. J. Stevens (to U. S. Atomic Energy Commission). U. S. Patent 3,018,460. Jan. 23, 1962.

A multiple-contact electrical connector is designed for facilitating correct alignment of the contacts of a movable component with the contacts in a normally stationary component. The stationary connector component, which is normally positioned in a panel, is provided with a flange-mount which permits rotary adjustment of the normally stationary connector component to a desired aligned position with respect to contacts in the other connector component. The flange-mount which comprises a flange on the connector component and a clamping ring may then be secured to the panel by drawing the clamping ring tightly against the flange, thus binding the latter between the ring and the panel for securing the component in desired fixed position. (AEC)

4269 VEHICLE FOR SLAVE ROBOT. Raymond C. Goertz and John F. Lindberg (to U. S. Atomic Energy Commission). U. S. Patent 3,018,980. Jan. 30, 1962.

A reeling device is designed for an electrical cable supplying power to the slave side of a remote control manipulator mounted on a movable vehicle. As the vehicle carries the slave side about in a closed room, the device reels the cable in and out to maintain a variable length of the cable between the vehicle and a cable inlet in the wall of the room. The device also handles a fixed length of cable between the slave side and the vehicle, in spite of angular movement of the slave side with respect to the vehicle. (AEC)

Heat Transfer and Fluid Flow

4270 (AERE-R-3845) AN ATTEMPT TO LOCATE INTERMETALLIC PARTICLES IN ZIRCONIUM ALLOYS USING A BITTER FIGURE TECHNIQUE. B. Cox and B. R. Harder (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 14p.

The compound $ZrFe_2$ is known to be ferromagnetic, and an attempt to locate particles of magnetic material in zircaloy-2 and dilute Zr–Fe alloys by a Bitter figure technique is described. An Fe_3O_4 sol in water-soluble plastic was used to prepare Bitter figures of the alloy surfaces in the form of replicas, which were then examined in an electron microscope. No magnetic particles were located in either zircaloy-2 or a Zr–O.3% Fe alloy. Subsequent work on specimens of $ZrFe_2$ showed that the failure to detect it in the dilute alloys arose because the size of the intermetallic particles in the latter was smaller than the size of the magnetic domains. (auth)

4271 (CEA-1825) INSTABILITES D'ECOULEMENT DU FLUIDE DANS UN CANAL CHAUFFANT REFROIDI A L'EAU. (Unstable Fluid Flow in a Water-Cooled Heating Channel). R. Delayre and J. P. Saunier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 55p.

Experimental investigations of the unstable behavior of a pressurized water flow in forced convection in a heating channel, with subcooled or bulk boiling, were carried out. Tests were conducted at 1140, 850, and 570 psi. The test section was 35-in. high, surmounted by a 25.4-in. riser. These sections were by-passed by a pipe where the flow was between 1 and 4 times the flow in the test section. The water velocity (in the test section) was between 1.6 and 6.6 ft/s. Under certain conditions perfectly stable oscillations with a period of several seconds were observed. A mathematical model was defined that was in agreement with the main characteristics of the oscillations. It seems that the dimensions of the riser had a determining effect: the inception of bulk boiling gave an important variation of the driving head, which could generate oscillations because of the non-zero delay for the system to reach its equilibrium. (auth)

4272 (NAA-SR-6681) POOL BOILING INVESTIGATION OF BENZENE, DIPHENYL, AND BENZENE–DIPHENYL MIXTURES UNDER PRESSURE. D. A. Huber and J. C. Hoehne (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-GEN-8. 66p.

Experimental measurements are reported for the nucleate boiling of benzene, diphenyl, and benzene–diphenyl mixtures. Heat flux is presented as a function of the temperature difference between the heat transfer surface and

the coolant saturation temperature. Correlations expressing nucleate boiling are discussed in view of the data. Critical heat fluxes are reported for all the fluids tested and are compared with correlations in the literature. The data were obtained in a pool boiling apparatus at pressures ranging from subatmospheric to 475 psig. System pressure was maintained with nitrogen gas. The test section was a horizontal, 6-inch long, $\frac{3}{8}$-inch OD, type 304 stainless steel tube which was heated by direct current; the tube itself was used as a resistance element. For the pure fluids, the nucleate boiling heat transfer data were correlated reasonably well by use of the Rohsenow, Gilmour, and Levy equations. The values of the critical heat fluxes for the pure fluids were best correlated by the Bernath relationship. However, none of the literature expressions adequately predicted the large increases in critical heat fluxes obtained when small percentages of benzene were added to diphenyl. (auth)

4273 (NRL-5675) HEAT-TRANSFER STUDIES ON SOME STABLE ORGANIC FLUIDS IN A FORCED CONVECTION LOOP. J. P. Stone, C. T. Ewing, C. H. Blachly, E. W. Steinkuller, J. R. Spann, B. E. Walker, and R. R. Miller (Naval Research Lab., Washington, D. C.). July 10, 1961. 21p.

Heat-transfer coefficients were measured for irradiated monoisopropylbiphenyl, tertiary eutectic (biphenyl with two terphenyls), irradiated tertiary eutectic, n-hexadecane, di(2-ethylhexyl) adipate, biphenyl, and monoisopropylbiphenyl heated in a long horizontal tube for the following conditions: bulk-fluid temperatures, 217 to 629°F; heat-transfer surface temperatures, 248 to 853°F; heat fluxes, 33,300 to 486,000 Btu/hr-ft^2; fluid velocities, 4.6 to 51.7 ft/sec; Reynolds numbers, 11,800 to 402,000; and Prandtl numbers, 4.1 to 24.9. These coefficients were correlated by an equation of the Dittus-Boelter type with an average deviation of ±5.5 percent. The physical properties of the fluids used for the correlation are included. No fouling of heat-transfer surfaces from decomposition of the polyphenyl fluids was observed in fouling runs up to 76 hours duration. In fouling experiments, the most severe conditions normally were: heat-transfer surface temperature, 850°F; bulk-fluid temperature, 600°F; and fluid velocity, 5 ft/sec. Component parts of the loop, consisting mainly of commercial "hot-oil" equipment, remained in good condition with a minimum of maintenance after four years of service. (auth)

4274 (TID-14004) FINAL REPORT—SECTION 1. AN ANALYSIS OF THE CRITICAL CONDITIONS AND BURNOUT IN BOILING HEAT TRANSFER. PART I. CRITICAL CONDITIONS. PART II. CRITICAL HEAT FLUXES. July 1961. SECTION 2. A CORRELATION OF BOILING HEAT TRANSFER FROM THE NUCLEATION THEORY—INCLUDING EFFECTS OF SYSTEM ACCELERATION AND FORCED CONVECTION. Yan-Po Chang (University of Notre Dame, Notre Dame, Ind.). Aug. 1961. Contract AT(11-1)-785. 120p.

Certain basic ideas were applied to boiling heat transfer from which several critical conditions were derived and an equation of the maximum heat flux in nuclear boiling was obtained. The heat transfer was considered as being limited by the maximum rate of bubble generation from a unit area of the heating surface. Heat transfer in nucleate boiling with and without forced convection and subcooling was also studied. With an empirical modification of the nucleation theory as developed by Volmer and Eyring from the Maxwell-Boltzmann distribution law, an equation was obtained for heat transfer in vigorous boiling. Validity of this equation was tested for 18 different systems under different pressures. (M.C.G.)

4275 (UCRL-9744) DOWNFLOW FORCED-CONVECTION BOILING OF WATER IN UNIFORMLY HEATED TUBES (thesis). Roger Maurice Wright (California. Univ., Berkeley and California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 21, 1961. Contract W-7405-Eng-48. 216p.

Local heat transfer coefficients and local, total two-phase pressure drops were measured in the downflow forced-convection (net) boiling of water in electrically heated tubes. The tubes used were 0.719 and 0.472 in. ID, with lengths of 5.67 and 4.69 ft, respectively. The flow variables cover the following ranges: mass flux G, 110 to 700 lbm/sec-ft^2; heat flux q, 13,800 to 88,000 Btu/hr-ft^2; quality (mass fraction vapor) x, 0 to 19%; boiling number (= $q/h_{fg}G$) B_o, 0.24 to 1.9 x 10^{-4}; pressure, 15.8 to 68.2 psia. Boiling heat transfer results are compared to the correlations of Dengler, Mumm, and Schrock and Grossman. New boiling heat transfer correlations are derived, the skeleton of these being $h_B \propto G^{0.6}\, q^{0.3}\, x^{0.4}$. Large effects due to two-phase thermal entrance phenomena were observed. These effects are discussed with reference to previous experiments in forced-convection boiling. Local, total two-phase pressure gradients are correlated by the method of Schrock and Grossman. Individual pressure gradients are also predicted by several methods. On the basis of heat transfer and pressure drop observations, the flow and vaporization mechanisms are discussed. A design procedure is derived and typical results are discussed. (auth)

4276 (VDIT-37) HEAT EXCHANGERS IN REACTOR TECHNOLOGY. A Literature Survey. Ernst Bock (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 112p.

An annotated bibliography is presented consisting of 298 references to the design and operation of heat exchangers for reactors covering the period 1943 to 1961. The references were taken from current periodicals, Nuclear Science Abstracts, and the card file of the Technical and Scientific Dept. of AB Atomenergi. Author and co-ordinate indexes are included. (B.O.G.)

4277 (AEC-tr-4496) HEAT POWER ENGINEERING. PART I. Translated from Teploenergetika. Vypusk 1 (A publication of the Publishing House of the Academy of Sciences, U.S.S.R., Moscow, 1959). 178p.

Discussions are included on studies of the generalization of experimental data on the circulation of water in steam boilers, regions of forms of flow of a steam-water mixture in an inclined pipe, steam and gas content during the bubbling process, pressure pulsations during the flow of gas-liquid mixtures in pipes, flow of a steam-water mixture in pipes by the γ-irradiation method, temperature field in combustion chambers, steam boiler of a solar heat power station, radiant heat exchange in gray-body systems, and use of the methods of indefinite coefficients in the solution of nonlinear problems of mathematical physics. (B.O.G.)

4278 (FTD-TT-61-51) CALCULATING THE TEMPERATURE FIELDS IN AN INSUFFICIENTLY HEATED LIQUID UPON BOILING UNDER CONDITIONS OF FREE CONVECTION. L. A. Latyshev. Translated from Izvest. Vysshikh Ucheb. Zavedenii, Aviatsion. Tekh., No. 3, 74-9 (1960). 9p.

The convection patterns in a vertical container of liquid with lateral weak heating surfaces are examined, and it is found that turbulent upward and downward flows cause a microvortex structure to appear on the surface of the liquid. A potential-field model is developed for calculating the temperature distributions in this type of flow, and the

results obtained with the model are compared with the observed temperature distributions and microvortex structure. (T.F.H.)

4279 (FTD-TT-61-153) HEAT EXCHANGE DURING BUBBLE BOILING. F. P. Minchenko. Translated from Energomashinostroenie, No. 6, 17-21(1960). 13p.

Results are given of a study of the heat transfer to boiling water and solutions of Li salts, with large-volume equipment and a circulation loop. An analysis and the general dependence of their criteria are given. This dependence was compared with the dimensionless formulas. (auth)

4280 (NP-tr-827) THESES REPORTS AND PAPERS AT THE CONFERENCE ON HEAT AND MASS TRANSFER. Translation of "Tezisy Dokladov i Soobshchenii na Soveshchanii po Teplo- i Massoobmenu, Minsk, June 5-9, 1961." 140p.

Eighty-six papers are included which were presented at the Russian conference on heat and mass transfer; most of the papers appear to be merely summaries of what was actually given at the conference. The papers are divided into sections dealing with solution of problems, phase changes, chemical conversions, drying processes and construction designs, and thermal properties of materials. Separate abstracts were prepared for 20 of the papers. (D.L.C.)

4281 (NP-tr-827(p.1-3)) CONCERNING CONFORMAL REPRESENTATIONS OF RADIATION FIELDS IN A VACUUM. S. P. Detkov. (Translation).

The possibility of conformal representations of radiation fields in vacuum is discussed along with their difficulties. The use of reflection lines is suggested. (D.L.C.)

4282 (NP-tr-827(p.5-6)) THE THEORY OF FREE CONVECTION. (THE SIMPLEST PROBLEM IN FREE CONVECTION—THE CALCULATION OF THE CIRCULATION IN A HOT-WATER HEATING SYSTEM). A. A. Pomerantsev. (Translation).

The problem of liquid circulation in the annular tube of a hot-water heating system with the heat source at the bottom in the case of free convection was treated by solving equations for continuity and momentum, thermal expansion of the liquid, and heat transfer from the tube to medium. An equation is presented for the temperature change throughout the tube length. (D.L.C.)

4283 (NP-tr-827(p.9-10)) THE NUMERICAL SOLUTION OF CERTAIN PROBLEMS INVOLVING THE MOTION OF LIQUIDS WITH VARYING VISCOSITY. L. M. Simuni. (Translation).

Equations are given for the velocity and temperature profiles of an incompressible liquid with a temperature-dependent viscosity and moving between parallel plates and in a plane tube. The equations are to be solved by successive approximation and numerical methods. (D.L.C.)

4284 (NP-tr-827(p.13-16)) LAWS GOVERNING THE HEATING OF BODIES OF SIMPLE SHAPE BY RADIATION AND CONVECTION. A. V. Kavaderov, Yu. A. Samolyovich, and V. N. Kalugin. (Translation).

A procedure is outlined for carrying out practical calculations for the heating of simple shapes under the conditions of radiative or convective heat transfer alone or in combination. (D.L.C.)

4285 (NP-tr-827(p.19-21)) CALCULATION OF HEATING OF RECTANGULAR BODIES IN TERMS OF TECHNOLOGICAL CONDITIONS. Yu. A. Samoylovich. (Translation).

Equations are given for calculating the heating of rectangular bodies for fixed conditions such as surface temperature, temperature gradient through the body cross section, heating rate, etc. (D.L.C.)

4286 (NP-tr-827(p.21-3)) THEORY OF DESIGN FOR REGENERATIVE HEAT EXCHANGERS. V. N. Timofeev (Timofeyev), V. M. Malkin, and F. R. Shklyar. (Translation).

Equations are given for the heat transfer in regenerators, and a method is outlined for solving the equations for use in design of regenerative heat exchangers. (D.L.C.)

4287 (NP-tr-827(p.27-9)) THE MELTING OF BODIES BY SUBJECTING THEM TO A FLOW OF GAS AT HIGH SUPERSONIC SPEEDS. V. Ya. Borovoi (Borovoy) and I. K. Toms. (Translation).

The problem of the motion of the melt in the liquid boundary layer formed at the surface of an axially symmetric solid subjected to a high-temperature gas flow is considered for the case of no chemical reaction or evaporation and for given heat transfer and viscosity coefficients. Equations are given for the approximate solution of the problem. The liquid layer is extremely small for solids of high thermal conductivity and low viscosity and appreciable for solids of low thermal conductivity and high viscosity. (D.L.C.)

4288 (NP-tr-827(p.32-4)) THE THEORY OF HEAT AND MASS TRANSFER IN THE CASE OF CONVECTIVE FLUID MOTION. A. A. Gryaznov. (Translation).

A mechanism for heat transfer, mass transfer, and momentum transfer from the main fluid flow to the solid wall is presented in which movement of fluid particles through the boundary layer directly to the wall and back is accounted for. The mechanism gave results which agreed with data on flow past a plate in the longitudinal direction, flow past a cylinder in the lateral direction, flow in a tube, and lateral flow over tube bundles. A general heat transfer equation is given for all four types of fluid flow. (D.L.C.)

4289 (NP-tr-827(p.38-40)) ON SOME RESULTS OBTAINED IN THE INVESTIGATION OF HEAT TRANSFER WITH A RAREFIED GAS IN THE CASE OF NATURAL CONVECTION. A. N. Devoino (Devoyno). (Translation).

The solution of the problem of heat transfer for a flat plate in viscous and molecular-viscous regimes is discussed for the cases where convection flow is present and where it is absent. (D.L.C.)

4290 (NP-tr-827(p.41-3)) PROBLEMS IN HEAT TRANSFER IN RAREFIED GASES. L. E. (Ye.) Kalikhman. (Translation).

The problems involved in convective heat transfer in rarefied gases are discussed. Methods and results are described for the case of a flat plane moving longitudinally in gas. The slippage effect is discussed. (D.L.C.)

4291 (NP-tr-827(p.48-51)) THE THEORY OF MELTING AND BURNING BODIES (STEFAN'S PROBLEM). A. A. Pomerantsev. (Translation).

The melting of a semibounded body is treated as a one-dimensional problem and solved with a method which sets the reference system into motion in order to hold the melt front stationary within the reference system. The melting of a thin wall is discussed. (D.L.C.)

4292 (NP-tr-827(p.56-8)) SOME BASIC PROBLEMS ENCOUNTERED IN CRITERIAL METHODS OF INVESTIGATING HEAT-TRANSFER SURFACES. E. M. Fainzil'ber (Faynzil'ber). (Translation).

Equations are given for the optimum geometric relationships for heat transfer surfaces of the tube bank type. (D.L.C.)

4293 (NP-tr-827(p.59)) FEATURES OF HEAT TRANSFER THROUGH A WALL WITH LONGITUDINAL FINS AS EXTENDED SURFACES IN THE CASE OF SURFACE BOILING OF THE COOLING LIQUID. V. K. Shcherbakov. (Translation).

An equation is given for the temperature distribution over a smooth surface at the base of the fin in a wall with longitudinal fins, under conditions of surface boiling of the coolant. (D.L.C.)

4294 (NP-tr-827(p.62-4)) THE THEORY OF CONVECTION HEAT TRANSFER IN THE CASE OF EVAPORATION. M. I. Ismailov. (Translation).

Evaporating particles lead to the appearance of turbulent motion in the boundary layer of the fluid flow at Reynolds' numbers substantially below the critical. The effect of evaporation on the mixing length is discussed. Precise solutions are derived for heat transfer and fluid flow under these conditions. Comparison of the theoretical results with experimental data shows good agreement. (D.L.C.)

4295 (NP-tr-827(p.66-7)) CRITICAL HEAT FLOWS IN THE CASE OF WATER BOILING IN CHANNELS. Z. L. Miropol'skii (Miropol'skiy) and M. E. (Ye.) Shitsman. (Translation).

A critical equation for the heat transfer in the forced motion of boiling liquid through channels is transformed on the basis of an analysis of experimental data. (D.L.C.)

4296 (NP-tr-827(p.71-2)) NEW RESULTS IN THE INVESTIGATION OF HEAT TRANSFER IN THE CASE OF SURFACE BOILING. N. G. Styushin. (Translation).

The heat transfer intensity in surface boiling depends on the number of existing steam-formation centers and hence on the saturation temperature. The point at which steam formation begins to affect the heat transfer (intensive boiling) is established at a certain flow temperature which bounds the region of intensive boiling from below. In the region of intensive surface boiling, flow temperature has no effect on the number of existing steam-formation centers. The heat transfer coefficient is the same as that calculated with the Sterman formula for developed boiling. (D.L.C.)

4297 (NP-tr-827(p.74-6)) INVESTIGATION OF THE EFFECT OF CERTAIN FACTORS ON SUBLIMATION CONDENSATION IN THE CASE OF ADIABATIC EXPANSION. Ya. Tsiborovskii (Tsiborovskiy) and Ya. Surgevich. (Translation).

Observations are reported on the effects of variables on the sublimation-condensation of naphthalene in mixtures with air by adiabatic expansion. (D.L.C.)

4298 (NP-tr-827(p.77-9)) INTENSIFICATION OF HEAT TRANSFER BETWEEN GAS AND SOLID SURFACE THROUGH USE OF INTERMEDIATE LIQUID HEAT CARRIER. I. T. El'perin. (Translation).

Heat transfer between a gas and the surface of a solid body is inefficient, and the possibility of using a liquid intermediate heat carrier to improve heat transfer is discussed. The liquid can be used in two ways: (1) with separate heating and cooling processes (gas never contacts surface), or (2) with combined processes (two-phase medium). (D.L.C.)

4299 (NP-tr-827(p.84-6)) AERODYNAMIC MEANS OF INTENSIFYING HETEROGENEOUS PROCESSES. K. M. Leonvich. (Translation).

The effect of flow structure on the heat and mass transfer in heterogeneous processes was investigated for the case of limited and constant consumption of a gaseous heat carrier. In axially symmetric flows, velocity and gas consumption changes cause almost no change in heat and mass transfer, while in nonsymmetric flows, heat and mass transfer from the flow to the wall can be varied within a wide range. Thus, it may be possible to raise the intensity of heterogeneous processes by aerodynamic means. The ratio of the velocity adjacent to the wall to the average flow is greater for nonsymmetric flows than for symmetric flows. (D.L.C.)

4300 (NP-tr-827(p.88-90)) THE SELECTION OF THE OPTIMUM DRYING REGIME FOR CERAMIC PRODUCTS MADE WITH PLASTIC MOLDS. M. S. Belopol'skii (Belopol'skiy). (Translation).

Methods are outlined for selecting the optimum drying regime for hollow clay shapes. The methods are based on determining the limit moisture differences at the instant of crack formation in a regime which causes internal and surface cracks. (D.L.C.)

4301 HEAT TRANSFER AND PRESSURE LOSS CHARACTERISTICS OF CROSS-FLOW TUBULAR ARRANGEMENTS WITH STUDDED SURFACES. N. G. Worley and W. Ross (Babcock and Wilcox Ltd., [London]). J. Brit. Nuclear Energy Conf., 6: 289-99(Oct. 1961).

Three rigs were used for heat transfer and pressure drop tests on bare tube and extended surface arrangements of practical interest in gas-cooled reactor boiler designs. The bare tube experiments were used to compare the results from the rigs with those of earlier work and to extend the range of the published data. The studded tube experiments were divided between atmospheric rig tests on a large number of tube designs and pressurized rig experiments on selected arrangements. A correlation for studded tubes using the tube diameter as the characteristic dimension brings to a single series of Nusselt number-Reynolds number lines, examples in which stud height, thickness, cross-section and arrangement on the tubes are varied. The pressure loss factors are sensitive to all of these variables. (auth)

4302 HEAT TRANSFER AND PRESSURE DROP PERFORMANCE OF HELICALLY FINNED TUBES IN STAGGERED CROSS-FLOW. C. Rounthwaite and N. Cherrett (Head Wrightson and Co. Ltd., Thornaby-on-Tees, Eng.). J. Brit. Nuclear Energy Conf., 6: 300-6(Oct. 1961).

Heat transfer tests were conducted on staggered arrangements of a given type of finned tubing in cross-flow, in which the two tube pitches were varied systematically. The gas heat transfer and pressure drop results are presented in the usual non-dimensional form. From these results heat-exchanger matrices of given duty were designed, which although of very different shape for the various tube configurations show little difference in total tube length. The latter result was used to deduce a relation, having certain theoretical justification, connecting corresponding heat transfer and pressure drop results. Existing pressure loss factor expressions give only a very approximate correlation of the pressure drop results. The pressure loss factors from the present tests appear mainly dependent on longitudinal tube-pitch, and almost independent of transverse pitch. (auth)

4303 FINNED TUBES IN A CROSS-FLOW OF GAS. A. Lymer and B. F. Ridal (Flexibox Ltd., Manchester, Eng.). J. Brit. Nuclear Energy Conf., 6: 307-13(Oct. 1961).

Methods and equipment, along with recent improvements, for measurement of heat transfer performance from a bank of finned tubes are outlined. A comparison of pressure drop coefficients is made from balance and static pressure measurements. Fin efficiency is calculated and measured. A water model using polystyrene beads as tracer material is described. Data are presented in graphical form. (L.N.N.)

4304 HEAT TRANSFER AND PRESSURE DROP CHARACTERISTICS OF CONCENTRIC ARRANGEMENTS OF HELICAL COILS. F. V. Davies (Superheater Co. Ltd., London) and J. Lis. J. Brit. Nuclear Energy Conf., 6: 314-23(Oct. 1961).

Tests concerning heat-transfer and pressure-drop characteristics of concentric arrangements of finned tube coils were performed. A closed test circuit in which air, heated electrically to ~200°F, was passed over the coils in the test section, the coils being cooled by 75°F water. The test circuit air flow gave test-section Reynolds number of $\sim 10^5$. The use of air instead of CO_2 and the comparatively low temperature level of the circuit are relatively insignificant. Results from a plain tube test section, the five-coil finned tube arrangement, and a three-coil finned tube arrangement are reported. Data were correlated satisfactorily over the entire range, and it is indicated that the data may be applied to the design of similar concentric arrangements comprising a different number of helical coils. (L.N.N.)

4305 FUEL ELEMENTS WITH AXIAL FINS AND HELICAL SWIRLERS. R. G. S. Skipper (General Electric Co. Ltd., Erith, Eng.). J. Brit. Nuclear Energy Conf., 6: 324-9(Oct. 1961).

The heat transfer surface of the GEC fuel element can is described, and the flow pattern produced in the cooling gas is discussed. A description is given of experimental techniques used to determine the can performance, including a discussion of problems arising from the provision of high heat fluxes from stainless steel heater bars. The over-all can performance is considered and local variations are discussed. A brief description of means of avoiding apparent local variations arising from the testing techniques is given. Effects of irradiation of the canned fuel on the heat transfer surface is considered and experimental techniques for evaluating them in the laboratory are described. The effect of reactor conditions of gas temperature and heat flux on heat transfer data obtained under less severe conditions is considered. (auth)

4306 HEAT TRANSFER AND FLUID FLOW INVESTIGATIONS ON LARGE-SCALE TRANSVERSE FINS. M. J. Harris (Univ. of Manchester, Eng.) and J. T. Wilson. J. Brit. Nuclear Energy Conf., 6: 330-6(Oct. 1961).

Development of the transverse fins used on Calder fuel elements is surveyed. Heat transfer and fluid flow investigations on large-scale transverse fins are described, and details are given of the apparatus used. The heat flux over this type of fin varies considerably with position and is consistent with the measured flow pattern in the fin gap. The latter consists of a well defined vortex in the top half of the fin gap, the flow in the lower half of the fin gap being relatively unsteady. The maximum speed in the fin gap is about one-third of the average value in the free stream. The effect of thermal conductivity on fin efficiency was studied by simulating various conductivities with the special test fin described. Local heat transfer coefficients do not vary appreciably over the range of conductivities investigated. Chamfering the fin tips has no obvious effect on the flow pattern. Speeds in the fin gap are slightly affected with a corresponding slight change in heat flux distribution. For the chamfer investigated there was an increase of approximately 10% in the net heat transfer from the fin. (auth)

4307 HEAT TRANSFER AND PRESSURE DROP PERFORMANCE OF SPIRAL POLYZONAL HEAT TRANSFER SURFACES FOR GAS-COOLED REACTORS. C. Cunningham and M. R. Slack (English Electric Co. Ltd., Whetstone, Leicester, Eng.). J. Brit. Nuclear Energy Conf., 6: 348-67(Oct. 1961).

A polyzonal fuel element heat transfer surface and associated gas flow pattern are discussed. Apparatus and techniques for measurement of the heat transfer and pressure drop performance of these surfaces are described. Experimental results supported by theoretical analysis lead to a correlation which can be used to predict the average heat transfer and pressure drop of a wide variety of shapes and which caters to variation in temperature, pressure, flow, and rating. Data on local variation in heat transfer over these surfaces are given, and methods of controlling this are demonstrated. (auth)

4308 INVESTIGATION OF THE POLYZONAL SPIRAL HEAT TRANSFER SURFACE AND ITS APPLICATION TO REACTOR DESIGN. A. F. E. Wise (Courtauld's Ltd., Coventry, Eng.). J. Brit. Nuclear Energy Conf., 6: 368-75(Oct. 1961).

Experimental programs and results for reactor fuel elements having polyzonal heat-transfer surfaces are reported for elements with 35 to 74 fins. Correlation formulas for friction-factor and heat-transfer data are derived and may be used for preliminary selection of heat-transfer surfaces to be studied in simulated reactor channels. It is concluded that for a given channel size and uranium rod diameter, a given pressure drop occurs with different combinations of fin-tip diameter and helix lead. The "best" can appears to have a short lead because the reduction in heat transfer that occurs in correcting from rig to reactor conditions is least with a short fin; for a given pressure drop, the cans with the shortest lead have the smallest fins; and for a given pressure drop, the can volume is a minimum with the combination of small fin-tip diameter and short lead. From a heat-transfer standpoint, a height of splitter of 0.5 in. appears adequate. (L.N.N.)

4309 EXPERIMENTAL AND THEORETICAL STUDY OF A NEW DEVICE FOR HEAT TRANSFER. A. Fortier, J. Le Foll, J. F. Faugère, O. J. Houseaux, J. Pelcé, B. L. Pierre, and E. de Robert (Commissariat à l'Énergie Atomique, Saclay, France). J. Brit. Nuclear Energy Conf., 6: 376-83(Oct. 1961).

A heat-transfer device is described which is a transverse-finned fuel element in which symmetrical secondary flows are induced by means of small delta-shaped vanes. Experimental results show considerable variation for a particular finned surface, depending on the shape and size of the inducing vanes. Flow configurations emerging from empirical tests are described. Detailed measurements of velocities and pressures were made in one particular arrangement. (L.N.N.)

4310 THE CEGB STUDIES HEAT TRANSFER. J. A. Hitchcock (Central Electricity Research Labs., Leatherhead, Eng.). Nuclear Power, 6: No. 68, 65-7(Dec. 1961).

The research programs of the British at CERL (Central Electricity Research Laboratories) are outlined as to the work being done in the field of heat transfer for nuclear power plants. Heat transfer work is examined in the production of fuel element cans, fundamental heat transfer theory, temperature measurement, advanced reactor systems, heat exchanger performance, and gaps in existing knowledge. The following three major test rigs are also discussed: an atmospheric pressure rig using air and taking a full-scale reactor channel and fuel element, a high-pressure rig using carbon dioxide with mass flow rates of the same order as in a reactor, and a heat exchanger rig

taking full-scale sections of tubing as in an actual heat exchanger. (N.W.R.)

4311 EFFECT OF EXTERNAL FIELDS ON THE MOTION AND GROWTH OF BUBBLES IN BOILING LIQUIDS. G. A. Akaryan (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1231-2(Oct. 1961). (In Russian)

It is noted that the growth of bubbles and boiling conditions of heated or saturated liquids can be controlled by employing external fields which act on the bubble motion on which the thermodynamic growth conditions depend. The growth of bubbles in an accelerated bubble chamber can either be slowed or accelerated. Local inhomogeneous electric or magnetic fields which keep the bubbles near the vessel walls or repulse them can be used to change the boundary conditions for boiling and heat exchange with the wall. The effects considered can be used to improve storage conditions of liquefied gases, heat exchange control, control of boiling, etc. (auth)

Instrumentation

Refer also to abstracts 4773, 4793, and 4982.

4312 (A/AC.82/G/L.689) MEASUREMENT OF THE CARBON-14 CONCENTRATION IN ESSENTIAL OIL USING THE LIQUID SCINTILLATION SPECTROMETER. Yosihiko Kasida, Mikio Yamazaki, and Tetsuo Iwakura (Japan. National Inst. of Radiological Sciences, Tokyo). Aug. 1961. 2p.

The concentration of C^{14} in thymol was measured by the liquid scintillation counting method, and its annual variation was observed from 1954 to 1960. Thymol was obtained from the essential oil of Orthodon perforatum. The annual variation of the concentration of naturally occuring C^{14} was detected with good reproducibility, using thymol methyl ether, and it was observed that the concentration increased since 1958. The data are tabulated. (P.C.H.)

4313 (A/AC.82/G/L.692) MEASUREMENTS WITH A WHOLE BODY COUNTER. Susumu Suguri (Japan Atomic Energy Research Inst., Tokyo). Aug. 1961. 16p.

The design and construction of a $20 \times 80 \times 200$ cm lead and steel chamber, used for measuring the radioactivity of human subjects, is described. The chamber contains a bed, under which are 9 plastic scintillation counters arranged so as to monitor the main sections of the body, A movable NaI(Tl) counter is also included above the bed. The K^{40}, Ba^{133}, and Cs^{137} spectra of an uncontaminated subject are shown, and the spectra of Ra- and Co-contaminated subjects are also presented. The chamber is designed for determinations of neutron exposure doses and natural body burdens, for identification of radionuclides, and for other health physics researches. (T.F.H.)

4314 (AFCRL-673) STATISTICAL STUDIES OF THE PERFORMANCE OF COSMIC RAY RECORDING INSTRUMENTS. Technical Note No. 6. Eric Dyring (Uppsala Univ. Inst. of Physics). Apr. 5, 1961. Contract AF 61(514)-1312. 28p.

A method to determine the variance of statistical fluctuations for instruments used in the registration of the cosmic radiation—the neutron monitor, the duplex cubical counter telescope, and the directional telescopes—is presented. The standard errors of data from cosmic ray instruments are estimated. The results are compared with the standard errors calculated from the theoretical Poisson distribution. It is stressed that the Poisson distribution will give an underestimation of the standard errors. (auth)

4315 (ANL-6446) SODIUM IODIDE AND SODIUM IODIDE CRYSTALS: THEIR USE IN SCINTILLATION COUNTING AND SPECTROMETRY. A Bibliography. Robert R. Kepple (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-Eng-38. 64p.

References (297) were obtained from Applied Science and Technology Index, Chemical Abstracts, Dissertations in Physics, Nuclear Science Abstracts, and Science Abstracts, Section A. The period covered was from 1948 through 1960. The arrangement is alphabetical by title; personal author and subject indexes are included. (P.C.H.)

4316 (AWRE-O-28/61) AN INTERCOMPARISON OF $4\pi\beta$ PROPORTIONAL COUNTING TECHNIQUES IN THE UK, USA AND CANADA. F. Brown and D. E. Watt (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Nov. 1961. 25p.

An intercomparison of β counting methods used in the assaying of $Sr^{90}-Y^{90}$, Na^{22}, and Co^{60} sources and solutions was organized among laboratories in the USA, Canada, and the UK. Results from this comparison have given information on the relative accuracy with which unknown radioactive solutions can be assayed and on the efficiencies of the various types of $4\pi\beta$ counter commonly in use. These data are compared with the true disintegration rates obtained by $4\pi\beta$-γ coincidence counting and calibrated $4\pi\gamma$ reference chamber techniques. Source preparation procedures including source conductivity, absorption from the solution, and self-absorption losses are discussed. (auth)

4317 (CERN-61-29) KINEMATIC ANALYSIS OF BUBBLE CHAMBER EVENTS: FIT, AN IBM 709 PROGRAMME IMPOSING MOMENTUM AND ENERGY CONSERVATION ON MEASUREMENTS OF COMPLETE EVENTS. R. Boeck (European Organization for Nuclear Research, Geneva). Oct. 19, 1961. 41p.

A program is described which adjusts track measurements of a bubble chamber event such that they obey the principles of momentum and energy conservation at all interaction points in the event. The measured parameters for a track are $1/p$, $\tan\lambda$ and φ (P = momentum, λ = dipping angle, φ = azimuthal angle). Not all of these parameters, however, need to be measured for all tracks but can be introduced as unknowns. The topology of the event and its interpretation given in terms of masses for inbound, outbound, and target particles is required as starting information. The "fit" is carried out according to the principles of the least squares method. The formulas and the organization of the programme are described and some results from test calculations are given. Possible extensions of the program are suggested. (auth)

4318 (CNEN-94) UN SISTEMA TRANSISTORIZZATO DI CONTEGGIO AUTOMATICO PER MISURE DI FISICA NUCLEARE. (A Transistorized System for Automatic Counting of Nuclear Physics Measurements). A. De Agostino, R. Marconero, U. Pellegrini, and A. Serra (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Aug. 1961. 28p.

A transistorized system is described for predetermined time and number pulses automatic counting. The number of counted pulses is registered by Hewlett-Packard 560A digital recorder. The assembling units can be connected in various ways in order to be able to change the experiment. The whole assembly is controlled by a programmer which can change, according to a predetermined program, the experimental conditions. (auth)

4319 (LA-2638) VARIATION OF RESPONSE (FRONT-TO-BACK EFFECT) IN CALIBRATING FILM BADGES TO A Co^{60} SOURCE. Ellery Storm and Harvey Israel (Los Alamos Scientific Lab., N. Mex.). June 1, 1961. Contract W-7405-Eng-36. 41p.

The Du Pont personnel-monitoring film packet has a flap arrangement on one side with a total thickness in the center of 69 mg/cm^2, whereas the other side of the packet has a total thickness of 29 mg/cm^2. Because of this difference in paper thickness, the film response to Co^{60} radiation varied, depending on whether the thick or the thin side of the packet was between the source and the film emulsion. With no filter and with the thick paper in front, a film response was obtained which was 10% less than that obtained with the thin paper in front because of increased absorption of electrons produced in materials surrounding the calibration set-up. With a filter and with the thick paper in front, a film response was obtained which was greater than that obtained with the thin paper in front, primarily because the thin paper in back absorbed fewer backscattered electrons from the filter. Front-to-back differences of 12, 17, and 14% were measured with the film packet sandwiched between filters of copper, cadmium, and lead, respectively. When an Eastman Type B packet was included in the film badge with the Du Pont packet, the effect on the Du Pont film was similar to that obtained by adding 150 mg/cm^2 of styrene plastic to one side of the packet. If the plastic was added to the thick side of the Du Pont packet, the front-to-back effect was 60, 29, 50, and 72% for no filter, and for the copper, cadmium, and lead filters, respectively. If the plastic was added to the thin side of the Du Pont packet, the front-to-back effect was 40, 10, 22, and 35%, respectively. A front-to-back effect was also measured with the Du Pont film packet exposed to beta rays from a uranium source. (auth)

4320 (NAA-SR-Memo-4789) THERMOCOUPLES TO MEASURE GRAPHITE TEMPERATURES IN THE HNPF MODERATOR CAN. J. D. Wilde (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1959. Contract [AT(11-1)-Gen-8]. 11p.

Profiles are given graphically for the thermocouple and graphite temperatures between washers for the present design and for a modified design. The profile for the present design shows that the thermocouples would run a maximum of 18.8°F hotter than the graphite, while with the modifications the thermocouple would run only 6°F higher than the graphite temperatures. (B.O.G.)

4321 (NAA-SR-Memo-6630) HOT-CELL GRIPPING TOOL AND FUEL-ELEMENT-DISCONNECT TESTS. J. R. Charles (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 3, 1961. Contract [AT(11-1)-Gen-8]. 19p.

Recommendations and results are given for determinations of the operating characteristics of the HNPF hot-cell gripping tool, the suitability of the fuel-element Mark II mechanical joint, and the effects of sodium exposure and steam cleaning on the mechanical joint and on the process-tube to fuel-cluster latch, including the effect of the exposure on extraction of a fuel cluster from a process tube. (B.O.G.)

4322 (NP-11090) EXPOSE DE METHODES EN SPECTROGRAPHIE α. APPLICATION AUX CORPS DE LA FAMILLE DU RADIUM NATUREL (These). (Outline of Methods in α Spectrography. Application to Compounds of the Family of Natural Radium (thesis)). Genevieve Bastin-Scoffier (Paris. Université). 1961. 113p.

Methods for magnetic spectrography of α particles are reviewed, and a particular experimental arrangement is described that is designed for studies of the highly excited states of α emitting nuclei. This apparatus is used to measure the α spectra from several nuclei in the Ra family: Po^{210}, Po^{214}, Po^{218}, Rn^{222}, Ra^{226}, Bi^{210}, Bi^{214}, and At^{218}. (T.F.H.)

4323 (NP-11120) DISTRIBUTION OF PATH LENGTHS IN A CYLINDRICAL IONIZATION CHAMBER FOR A HOMOGENEOUS ISOTOPIC FLUX. Technical Report 60-19. Philip Schwed and Wayne A. Ray (RIAS. Div. of Martin Co., Baltimore). Oct. 1960. 34p.

Calculations were made to determine the probability that the path length for particles lies in a certain range in a counter of cylindrical configuration, for varying ratios of length to diameter, in an isotropic flux of particles sufficiently energetic not to be trapped inside the counter. The results permit the determination of the extent to which the observed pulse heights vary with the path lengths. To the extent that this effect can be isolated, it becomes possible to infer from the pulse height distribution the variation of the flux with the atomic number of the nuclei composing it. (B.O.G.)

4324 (NP-11135) PRINTED CIRCUITS AND WELDED MODULES: AN ANNOTATED BIBLIOGRAPHY. George E. Owens, comp. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Aug. 1961. 85p. (SB-61-52)

References (248) on design standards and procedures, production methods and techniques, and applications of the fabricated items are given to books, patents, and U.S. and foreign reports and journals published from March 1954 through July 1961. The references are arranged first by year of publication and then by author or title. A subject index is appended. (P.C.H.)

4325 (ORNL-3126) THE ORNL BADGE DOSIMETER AND ITS PERSONNEL MONITORING APPLICATIONS. W. T. Thornton, D. M. Davis, and E. D. Gupton (Oak Ridge National Lab., Tenn.). Dec. 21, 1961. Contract W-7405-Eng-26. 62p.

Historical developments of the ORNL dosimeter and the ORNL badge meter, Model II, are discussed. Beta-gamma and neutron dosimetry techniques are described. ORNL film dosimetry experiments are summarized. (M.C.G.)

4326 (ORNL-TM-77) GUIDE FOR THE DESIGN OF SAFETY INSTRUMENTATION FOR EXPERIMENTS IN THE LITR AND ORR. J. T. DeLorenzo (Oak Ridge National Lab., Tenn.). Dec. 11, 1961. Contract [W-7405-eng-26]. 25p.

A guide for the design of the safety instrumentation for experiments which are to operate in the LITR and ORR is presented. It is not intended to provide the detailed information that is still needed to complete an acceptable instrumentation scheme. This information may be obtained upon consultation with the ORNL Instrumentation and Controls Division. (auth)

4327 (PAN-242/I-B) TEKHNOLOGIYA I KHARAKTERISTIKI KREMNIEVYKH SCHETCHIKOV α-CHASTITS. (Technology and Characteristics of α-Particles Silicon Counters). Ya. Khvashchevska, K. Dybovski, and S. Khvashchevski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). June 1961. 10p.

The technology and characteristics of Au-Si type counters for α particles are described. It is found that the majority of these counters is suitable for energy measurements of α particles. The detectors have resolution power lower than 5 percent. (auth)

4328 (Y-1372) AN INVESTIGATION OF THE SOLID PARTICULATE COLLECTION EFFICIENCY OF THE TRAVERSE-TYPE STACK PROBE. R. B. Schappel (Union Carbide Nuclear Co. Y-12 Plant, Oak Ridge, Tenn.). Oct. 21, 1961. Contract W-7405-Eng-26. 59p.

The collection efficiency of the traverse-type probe for sampling dry uranium particulate matter in flowing vapor was evaluated in a series of stack spiking tests. The information is required for application in the continuous sampling of plant vapor exhaust streams. The traverse-type probe was found to be capable of representative sampling of stack particulates, but only one-fourth of the sample entering the probe reached the collection point (filter paper) located on the outside of the stack. The remaining three-fourths deposited on the interior walls of the probe. (auth)

4329 (JPRS-10581) THE METHODS AND PROBLEMS OF MODERN DOSIMETRY. Laszlo Bozoky. Translated from Fiz. Szemle, 11: No. 5, 135-41(May 1961). 4p.

Requirements for dosimeters are summarized, such as directional insensitivity, energy independence, distinction between various types of radiations, calibration characteristics, time constants, saturation properties, and durability. The use of ionization chambers as dosimeters is discussed. It is noted that no satisfactory dosimeters exist for photons above 3 Mev, medium energy neutrons, or doses from impulse devices. (T.F.H.)

4330 (JPRS-10920) NEWS OF HIGHER EDUCATIONAL INSTITUTIONS MINISTRY OF HIGHER AND SECONDARY SPECIALIZED EDUCATION RADIO ENGINEERING SERIES. Translation of Izvest. Vysshikh Ucheb. Zavedenii, Radiotekh., 4: No. 1, 3-124(1961). 179p.

A translation of the journal Izvestiya Vysshikh Uchebynkh Zavedenii, MVSSO, Seriya Radiotekhnika, Vol. 4, No. 1, 1961, pp.3 to 124. Topics covered include technology and theory of electric information systems, on the theory of a diaphragmmed rectangular waveguide, coupling normal waves in waveguide with ferrites, research into speech and hearing, generator of pulsed magnetic fields with high pulse recurrence frequency, analysis of errors in phase frequency meters, current distribution in an aerial with non-mechanical scanning, a transistorized unsaturated pulse amplifier for digital computer systems, use of simultaneous amplitude and phase modulation in radio broadcasting, investigation of self-oscillator for recording changes in the Q-factor of the oscillatory system, a heavy current pulse generator for the investigation of ferromagnetic materials, permissible regimes for electrovacuum devices working with long pulses, decoupling circuits for low-power pulse devices, use of a clamping diode instead of an accelerating capacitance, terminology for use with semiconductor electronics units, terminology in semiconductor electronics, and fundamental ultra-high-frequency electronics. One separate abstract was prepared. (M.C.G.)

4331 (NP-tr-830) VARIATION OF PHOTOMULTIPLIER GAIN AS A FUNCTION OF PULSE RATE. R. Chéry. Translated by R. Matthews (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from J. phys. radium, 21: 679-80(1960). 7p.

When using a slow-fast coincidence spectrometer unit, abnormal variations were observed in the gain of photomultipliers as a function of source intensity. Studies were made to discover a technique affording an improvement in photomultipliers in this respect. Findings suggested that the gain variation due to instability of the secondary multiplication factor of the first dynodes could be overcome by irradiating the photomultiplier under dissipation limit conditions compatible with safety. The tubes were therefore subjected to continuous irradiation for 15 and 30 hr. There was a quite clear stabilization in the gain as a function of counting rate up to supply voltages of 1400. (M.C.G.)

4332 (NP-tr-831) THE CHOICE OF A DETECTOR FOR MEASURING THE THICKNESS OF THICK MATERIALS. K. H. Waechter. Translated by L. F. Secretan (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atompraxis, 6: 385-91(1960). 27p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 4214.

4333 USE OF A GETTER-ION TYPE PUMP WITH A MASS SPECTROMETER. A. A. Ebert, Jr. (E. I. du Pont de Nemours & Co., Wilmington, Del.). Appl. Spectroscopy, 15: 152; 154-5(1961).

The advantages, with respect to maintenance, and use of this type pump in the mass spectrometer are described. The life of the pump is a function of the pressure in the system and ultimately depends on the supply of titanium in the pump because titanium is necessary to maintain the pumping action. With self-regulating behavior, the pump can be expected to have a life of several years, if it is operated at very low pressure. From an operational standpoint, the principal advantage of the electronic pump is the cleaner spectral background it provides. Aside from improved backgrounds, little change is noted in general spectrometer performance. (P.C.H.)

4334 EXTRAPOLATION COUNTER FOR THE ABSOLUTE DETERMINATION OF C^{14}. D. Modes and M. Leistner (Institut für Angewandte Radioaktivität, Leipzig). Atomkernenergie, 6: 363-5(Sept. 1961). (In German)

The determination of the absolute activity is accomplished by adding CO_2 containing C^{14} to the counting gas of a cylindrical proportional counting tube. The CO_2 was produced from $BaCO_3$. With propane as the counting gas and a 10^4-fold external amplification, plateaus of 800 to 1000 v length with an increase of 0.1%/100 v are obtained. The length of the counting tube may be varied from 0 to 30 cm so that corrections necessitated by field inhomogeneities at the counting tube end can be determined by extrapolation toward infinite counting tube length. Losses caused by particles originating near the counting tube wall and absorbed by it are so small that they are negligible. After determining the chemical purity of the measured $BaCO_3$ samples, their specific activity can be stated with an error of ≤3%. (auth)

4335 A METHOD FOR MEASURING NEUTRON-FLUX PROFILES. D. Kompe (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 389-92(Nov. 1961). (In German)

A method for measuring neutron flux in reactors by the irradiation of ribbon-shaped copper probes is described. The continuous distribution of induced β activity along the ribbon corresponds to the flux distribution during activation. An automatic device was constructed for this method. (auth)

4336 THE MEASUREMENT OF EPITHERMAL NEUTRON SPECTRA BY USE OF RESONANCE DETECTOR FOILS (SANDWICH METHOD). G. Ehret (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 393-400(Nov. 1961). (In German)

A simple method for the measurement of epithermal neutron fluxes in reactors is described. After a sandwich made from three foils of equal thickness is activated in the neu-

tron flux the difference activity between the outer and the inner foil is determined. This difference activity is directly proportional to the neutron flux at the main resonance of the foil material. The activation by neutrons of other energies is nearly equal for the inner and the outer foils and cancels if the difference is formed. Measurements were made using Indium (resonance energy 1.46 ev), Gold (4.9 ev), Tungsten (18.8 ev), Lanthanum (73.5 ev) and Manganese (337 ev). The method was used to determine the epithermal neutron spectrum of the Karlruhe Research Reactor FR 2. (auth)

4337 MEASUREMENT OF QUANTUM RADIATION IN THE ENERGY RANGE OF 3–30 kev WITH LARGE-SURFACE PROPORTIONAL COUNTERS. H. Fessler, H. Kiefer, and R. Maushart (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 401-7(Nov. 1961). (In German)

A large-area three-stage proportional counter containing three flat counting chambers with an effective counting surface of about 300 cm^2 is described. These chambers are housed together in a cylindrical case and are separated from one another electrically by a zero-potential grid. The absorption of low-energy quantum radiation in argon was determined with these counters and compared with the theoretical values. The two outer chambers are connected with the inner chamber by an anticoincidence circuit, thus making possible an extremely low background effect of 0.03 $imp/cm^2 \cdot min$ in the energy range of 10.5 to 22.5 kev used for plutonium measurements without additional shielding. The half width of the 14 kev plutonium line is 11%. Certain practical applications of this device in radiation protection are mentioned, especially the separation of plutonium in uranium at a weight ratio of $1:10^6$, and in vivo measurements of plutonium in man. (auth)

4338 USE OF THE GRAY WEDGE-METHOD IN γ-SPECTROSCOPY. M. Hollstein and H. Muenzel (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 407-12 (Nov. 1961). (In German)

The use of gray wedge-spectroscopy for the determination of energy and intensity of γ-rays was investigated. The procedure described permits the determination of energies and of relative or absolute intensities with a standard deviation of $\pm 1\%$ and $< \pm 10\%$, respectively, in simple spectra with exposure times of a few minutes. The accuracy of the method should be sufficient for the determination of several photopeaks in a single spectrum. (auth)

4339 ANALYSIS OF SIMPLE AND COMPLEX GAMMA SPECTRA. Thomas Schneider and H. Muenzel (Kernforschungszentrum, Karlsruhe, Ger.). Atompraxis, 7: 412-19 (Nov. 1961). (In German)

A compilation is given of the most important methods for analyzing gamma scintillation spectra. The quantitative evaluation of pulse spectra with few, widely spaced photopeaks is discussed. The analysis of complex spectra is described. (auth)

4340 A RADIATION MONITOR WITH SELF RESETTING WARNING ARRANGEMENT. T. Friese, G. Hase, H. Klessmann, and A. Pichler (Hahn-Meitner-Institut für Kernforschung, Berlin). Atomwirtschaft, 6: 554-6(Nov. 1961). (In German)

A radiation detector for monitoring radiation levels in laboratories is described in which Geiger-Mueller counters with halogen or organic filling serve as detectors. The monitor has both optical and acoustic pulse indicators as well as an average value indicator and contains in addition a self re-setting acoustic alram. The threshold value for this may be chosen in two ranges each with six steps. (auth)

4341 RECOMBINATION IN PARALLEL PLATE FREE-AIR IONIZATION CHAMBERS. Patricia B. Scott and J. R. Greening (Edinburgh Univ.). Brit. J. Radiol., 34: 791-800(Dec. 1961).

Consideration is given to the choice of the formula which best describes recombination between parallel plates. This formula is modified so that it may be applied to free-air ionization chambers. The modifications entail determining the effective width of a circular cross-section x-ray beam, the effect of space charge and the effect of ion spread and distribution. The modified formula is checked experimentally with a small free-air chamber by varying field strength, dose-rate, beam quality and size and shape of the x-ray beam. Good confirmation is obtained. (auth)

4342 BULLETIN OF NUCLEAR INSTRUMENTATION NO. 8. Bull. inform. sci. et tech. (Paris), No. 54, 19-50 (Sept. 1961). (In French)

Information concerning present studies and developments in instrumentation at the Commissariat à l'Energie Atomique is given. (P.C.H.)

4343 THE INITIAL TRANSIENT BEHAVIOR OF A THERMOELECTRIC GENERATOR. F. G. Stremler (Univ. of Michigan, Ann Arbor) and P. E. Gray. Commun. and Electronics, No. 56, 367-72(Sept. 1961).

The problem of predicting the time-dependence of the output current is treated first, followed by consideration of the important problem of device setting time. Since the system is nonlinear in terms of current, a perturbative method is used to obtain solution. The effect of load on the transient behavior is also discussed. (P.C.H.)

4344 ELECTRIC ANALOG OF TRANSPORT PHENOMENA IN A THERMOELECTRIC GENERATOR. M. E. Talaat. Commun. and Electronics, No. 56, 427-31(Sept. 1961).

The basic principles of thermoelectric transport phenomena and those of heat transfer are used to derive an electric circuit analog of an arm of a thermoelectric couple where the thermal conductances are represented by electric conductances, and where the rates of input heat (Peltier, Joule, and Thomson heat) and the electric power output are represented by current sources. The equivalent thermal circuit is shown to satisfy the transport equations of one of the arms of a thermoelectric couple. The basic equivalent thermal circuit of an arm of a thermoelectric couple is next applied to the derivation of an over-all thermal equivalent circuit of a typical isotope-fueled thermoelectric generator. The electric analog of the entire system enables the designer to determine the over-all efficiency of the thermoelectric generator as well as its temperature distribution, and to set the problem on the analog or digital computer and vary the different parameters of the circuit to optimize the over-all design. (auth)

4345 MEASUREMENT OF VERY HIGH ELECTRICAL RESISTANCES USING IONIZATION CHAMBERS AS SOURCES OF CURRENT. Daniel Blanc, Robert Lacoste, Jean Lagasse, and Albert Larribe (Faculté des Sciences, Toulouse, France). Compt. rend., 253: 1929-31(Oct. 30, 1961). (In French)

The internal resistance of the chamber attains 10^{18} Ω (pressure: 2 cm of mercury) if a diaphragm is placed on the carrier-source electrode; the upper limit of the measurable resistances are thus reached at 10^{17} Ω. The employment of a screen grate conducts an analogous improvement. (tr-auth)

4346 EXPERIENCE WITH SEMI-CONDUCTING DETECTORS. M. Skřivánkova (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague). and Z. Trousil. Czechoslov. J. Phys., B 11: 755-63(1961). (In English)

Silicon detectors with deep surface potential barriers are described, and their use in the spectrometry of charged particles is discussed. (auth)

4347 MAGNETIC SPECTROMETER FOR INTERNAL CONVERSION ELECTRONS EMITTED IN (n, γ) REACTIONS. V. I. Pelekhov and A. F. Malov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1069-83(Sept. 1961). (In Russian)

Descriptions are given of an experimental installation with a special magnetic spectrometer for analyzing internal conversion electrons emitted during radiative capture of thermal neutrons. Electron-optical characteristics of the spectrometer are analyzed and the spectrum of internal conversion electrons obtained with a Cd^{113} target is given. (R.V.J.)

4348 APPLICATION OF IONIZATION α SPECTROMETER WITH TIME ANALYZER FOR DETERMINING HALF-LIFE PERIODS. Yu. M. Volkov, A. P. Komar, G. A. Korolev, and G. E. Kocharov (Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1188-96(Sept. 1961). (In Russian)

Descriptions are given of an ionization α spectrometer with a time analyzer for determining half life by correlating α pulse distribution time with the pulse time of the parent substance. The Po^{215} half life measured with the α spectrometer showed a higher degree of accuracy (0.3%) than previous data derived with a rotational disc. In the suggested device α particles are separated by energy, thus reducing the random coincidence background and enabling measurements without interference from α particles of other energies. The multichannel analyzer is capable of much faster performance than integral or differential methods. The application of a 4π counter with low background permits measurements of half lives up to 10 sec. (R.V.J.)

4349 SEMICONDUCTOR-SPECTROMETERS FOR CHARGED PARTICLES. L. A. Zubritskii, A. I. Popov, P. V. Sorokin, and V. F. Samoĭlov (Khar'kov State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1286-90(Oct. 1961). (In Russian)

According to recent publications, semiconductor devices used as spectrometers yield better results in the study of charged particles than scintillation spectrometers or ionization chambers. The space charge under inverse transition voltage represents the sensing element. Several Ge and Si semiconductor spectrometers were examined, making use of Po^{210} α-particles for testing the spectroscopic properties of the detectors. The Au–Ge type spectrometers used at liquid N temperature showed improved resolution when the voltage was increased to 5 v; beyond 30 v the resolution became worse. Spectrometers using Si had a resolution of 3% in the range of 5 to 10 v; beyond that the noise level affected the resolution. At higher voltages the change from 50 to 180 v resulted in only a 2.5% change in the resolution. The effective width of the sensitive layer was also determined. The maximum energy of the scattered protons was 2.2 Mev. (TTT)

4350 AN 11-COUNTER DEVICE FOR MEASURING THE $\gamma\gamma$-ANGULAR CORRELATION. A. I. Belyaevskii and Yu. A. Gur'yan (Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1291-1301(Oct. 1961). (In Russian)

Determination of the $\gamma\gamma$-angular correlation is useful for obtaining information about the spin of excited nuclei and multipolarity of radiations. Its dependence on extranuclear fields makes possible the measurement of the magnitude and the sign of the gyromagnetic ratio. Measurements were undertaken with a multichannel device which is suitable when the radiation of the cascades is isotropic or when it presents an axial symmetry; it had a higher effectiveness than the usual 2-counter, single-channel analyzer and made it possible to work with short-life isotopes and with weak sources. The system included a matrix with a 2-channel fast-slow coincidence scheme for the amplitude selector, a simultaneous stabilization and adjustment unit, and a triggering control mechanism. For testing the system, a Sc^{46} (892-1118 kev cascade) and a Na^{22} (511-kev annihilation quanta–1270-kev transition) source were used. (TTT)

4351 BETA-SPECTROMETER PROVIDED WITH DOUBLE FOCUSING UNDER AN ANGLE OF $\pi\sqrt{2}$. S. A. Shestopalova (Mendeleev All-Union Scientific Research Inst. of Metrology, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1302-4(Oct. 1961). (In Russian)

The requirement of good resolving power and high luminosity is best achieved with a β-spectrometer provided with double focusing under an angle of $\pi\sqrt{2}$. In addition, scattering and background within the instrument must be kept to a minimum. These problems were solved by placing thin-wall G-M counters beyond the foci of the instrument and using a coincidence method. The instrument was tested with a Cs^{137} source: at zero-current on the magnet the accidental and cosmic-ray background was less than 1 coincidence per 40 hours; for the hard β-spectrum the background was less than 1 coincidence per 10 hours. (TTT)

4352 USE OF IONIZATION CHAMBERS FOR PARTICLE SELECTION ON THE BASIS OF THE MEASUREMENT OF THE MAGNITUDE E dE/dx. Yu. V. Gofman, V. N. Dobrikov, N. I. Zaika and O. F. Nemets (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1305-7(Oct. 1961). (In Russian)

The simultaneous measurement of the energy and of the specific energy loss of particles makes it possible according to Bethe to differentiate between particles such as protons, deuterons and tritons which have identical charges but widely different masses. Ionization chambers are much more suitable for this type of measurement than scintillation counters because they may be provided with selector electrodes of the desired length for measuring the energy or the specific energy loss of the particles. In addition, a change of the gas pressure in the chamber adapts it for measurements in the desired range. A modified version of the chamber described by N. I. Zaika et al. (Izvestia Akad. Nauk SSSR 23: 1460 (1960)) was used. On the basis of the 13.6-Mev maximum energy of the cyclotron neutrons, 5 and 31-cm long electrodes were used, connecting them with pulse totalizer and amplifying devices. The output of the amplifier was separated in particle groups according to their mass by a multichannel analyzer or another discriminator. Satisfactory separation of the protons, deuterons and tritons from the Be^{9} + d reaction was obtained with the device. (TTT)

4353 ABSOLUTE MEASUREMENT OF THE CROSS SECTIONS OF (n,p) AND (n,d) REACTIONS WITH A COINCIDENCE TELESCOPE. P. Lévy and Bonnel (Laboratoire de Synthèse Atomique et d'Optique Protonique [Ivry-sur-Seine, France]). J. phys. radium, 22: 489-99(Aug.-Sept. 1961). (In French)

In order to study selectively (n,p) and (n,d) reactions for various elements, an arrangement containing a coincidence telescope was built allowing differentiation of particles by observation of the coordinates of a spot on an oscilloscope. Together with absolute measures of neutron flux, this installation allows one to measure total and differential nuclear reaction cross sections. $F^{19}(n,d)O^{18}$ and deuteron break-up reactions are given as illustrative examples, and the results are compared with earlier results. (auth)

4354 POINT MEASUREMENT OF THE DOSE-POWER DISTRIBUTION OF γ SOURCES WITH MICRODETECTORS. H. Ulbrich and C. Hamann (Institut für Angewandte Physik der Reinstoffe, Dresden, Ger.). Kernenergie, 4: 646(Aug. 1961). (In German)

A brief description is given of two devices for the determination of dose-power distribution of γ sources. The first detector consists of a plastic scintillator in combination with a photoelement. The second detector is a semi-conductor detector. The performance of the detectors for measurement of the dose-power distribution of large γ sources was satisfactory. (J.S.R.)

4355 MEASUREMENT OF STOPPING-POWER RATIO FOR CAVITY IONIZATION CHAMBERS. T. E. Burlin (Hammersmith Hospital, London). Nature, 192: 545-6 (Nov. 11, 1961).

An absolute measurement of the stopping-power ratio is made by varying the pressure of different gases introduced into a single ionization chamber. The method is shown graphically by showing the variation in the ionization/g of gas with the gas pressure for hydrogen, air, and argon in a graphite ionization chamber irradiated by 1.25-Mev photons (Co^{60} gamma rays). (N.W.R.)

4356 KINETICS OF DISSOCIATION OF ETHYL HALIDES IN SELF-QUENCHING GEIGER-MULLER COUNTERS. I. Zlotowski and H. Wincel (Univ. of Warsaw). Nature, 192: 550-1(Nov. 11, 1961).

Decay curves and quenching characteristics of ethyl halides C_2H_5X (X = Cl, Br, and I) used as quenching vapors are presented in order to show the primary decomposition of excited ethyl halide molecules or ions in a working Geiger counter. The decay curves are shown to have an initial very fast consumption of parent molecules which comes to an end after the first 10^7 to 10^8 pulses followed by a slow decomposition process. Assuming that the observed fast consumption process is due primarily to strong adsorption phenomena occurring on freshly degassed electrode and glass surfaces, it seems reasonable to expect that only very few undecomposed parent molecules will reach the wall of the counter. (N.W.R.)

4357 PHOTOFLUORESCENCE DECAY TIMES OF ORGANIC PHOSPHORS. T. D. S. Hamilton (Rhodes Univ., Grahamstown, South Africa). Proc. Phys. Soc. (London), 78: 743-52(Nov. 1, 1961).

An accurate and convenient method for measuring photofluorescence decay times in the nanosecond region is described. Results are given for a number of organic compounds, and reasons for differences with previous results are discussed. For anthracene, a value of 24.2 nsec was measured for a 1 cm cube crystal. Some previous results for quantum efficiencies are corrected on the basis of these measurements and apparent inconsistencies examined with regard to the mean free path of excitons in very thin crystals. (auth)

4358 NUCLEAR PHYSICS. PART A. Luke C. L. Yuan and Chien-Shiung Wu, eds. Methods of Experimental Physics. Volume 5. New York, Academic Press, 1961. 751p. $18.00.

The interactions of radiation with matter are reviewed, with regard to the applications of these interactions in detectors and counters. The characteristics and uses of various types of detectors are summarized, including ionization chambers, gas-filled counters, scintillation counters, luminescent chambers, Cherenkov counters, cloud chambers, bubble chambers, emulsions, semiconductor detectors, and spark chambers. Methods are described for measuring the charge and size of nuclei and other particles. Methods are also surveyed for measuring the momentum and energy of charged particles, neutrons, γ rays, and neutrinos. (T.F.H.)

4359 CONTROLLED-POTENTIAL AND DERIVATIVE POLAROGRAPHY. M. T. Kelley, D. J. Fisher, W. D. Cooke, and H. C. Jones (Oak Ridge National Lab., Tenn.). p. 158-82 of "Advances in Polarography. Vol. 2." I. S. Longmuir, ed. [New York], Pergamon Press, 1960.

The problems of sensitivity, resolution, and cell resistance and results obtained with a controlled-potential and derivative polarograph are discussed. A description of the polarograph is also given. With this polarograph, several types of polarograms may be recorded: undamped, average-current, and maximum-current regular and derivative polarograms. The oscillations due to the growth and fall of the DME drops are removed by either the parallel-T filter or the peak follower and the peak follower removes them without introduction of appreciable time lag. The controlled potential feature also has several advantages. The electronic scan circuit has less noise and is easier to fabricate and to use. It was found that derivative polarograms have greater resolution than undamped regular polarograms. (P.C.H.)

4360 IMPROVEMENTS IN OR RELATING TO A NEUTRON DENSITY MEASURING DEVICE. Price Davis Wickersham, Dieter Lotar Rall, and Warren Harding Giedt (to American Radiator & Standard Sanitary Corp.). British Patent 884,282. Dec. 13, 1961.

A device for measurement of neutron flux intensities by measuring the heat produced by the flux in certain materials is designed which is safe, simple, and cheap, has a rapid response time, and is independent of the ambient temperature. The device comprises in combination a thin layer of neutron-sensitive material, a thermal resistance, and a thermopile disposed around the thermal resistance with hot and cold junctions on opposite sides. A particular configuration of the device gives a response time of less than 25 msec. (D.L.C.)

4361 IMPROVEMENTS IN OR RELATING TO RATE-METER CIRCUITS. Frank Hugh Hale and Henry John Reid (to United Kingdom Atomic Energy Authority). British Patent 884,317. Dec. 13, 1961.

A circuit is designed for preventing malfunction of rate meters, e.g., due to overload by excess radiation flux. The circuit comprises a switching circuit which, if the supply voltage falls below a predetermined value, connects the meter to a current source which maintains the meter reading at full scale. (D.L.C.)

4362 RADIOACTIVITY MEASURING APPARATUS. (to Packard Instrument Co. Inc.). British Patent 884,349. Dec. 13, 1961.

An apparatus is designed for successively and automatically measuring the activities of a relatively large number of samples. The background radiation is kept constant by maintaining a uniform spacing between the detector and the stored samples which are disposed in a circular array about the detector, and the shielding required around the detector is reduced. A mechanism is provided which trans-

fers automatically samples in a vertical position and is useful for test tubes containing radioactive liquids. (D.L.C.)

4363 AMPLITUDE DISCRIMINATOR HAVING SEPARATE TRIGGERING AND RECOVERY CONTROLS UTILIZING AUTOMATIC TRIGGERING. R. L. Chase (to U. S. Atomic Energy Commission). U. S. Patent 3,018,386. Jan. 23, 1962.

A transistorized amplitude discriminator circuit is described in which the initial triggering sensitivity and the recovery threshold are separately adjustable in a convenient manner. The discriminator is provided with two independent bias components, one of which is for circuit hysteresis (recovery) and one of which is for trigger threshold level. A switching circuit is provided to remove the second bias component upon activation of the trigger so that the recovery threshold is always at the point where the trailing edge of the input signal pulse goes through zero or other desired value. (AEC)

Materials Testing

4364 (SCL-T-390) THE QUANTITATIVE DETERMINATION OF THE STATES OF STRESS OCCURRING IN TRANSVERSELY IMPACTED BEAMS USING SPARK CINEMATOGRAPHY AND STRESS OPTICS. H. H. Emschermann, R. Flossmann, and K. H. Ruehl. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from p.38-44 of "SELECTED PAPERS ON STRESS ANALYSIS." Presented at the Institute of Physics, Stress Analysis Group Conference, Delft, The Netherlands, 1959. (A Publication by Chapman and Hall, Ltd., London, and Reinhold Publishing Corp., New York, 1961). 10p.

The shear stress and shear force distributions were determined in plain and notched beams impacted transversely at the center by a falling mass. A polariscope with spark illumination supplies six photographs at time intervals adjustable between 10^{-3} and 2.5×10^{-8} seconds by means of a variable delay unit. Without this unit, the interval between consecutive pictures can be shortened to 10^{-7} second by adjustment of the coupling element. From several series of consecutive pictures of fringes and isoclinics, the shear stress distributions can be determined quantitatively. In addition, the strains at the bottom edge of the beam are measured by wire resistance strain gauges. The fringe pictures and local stress distributions give a clear understanding of the phenomena in the impacted beams during the first 200 μsec. (auth)

4365 (TG-230-T256) INTROSCOPY — [FLAW DETECTION]. L. Dun, G. Lushnikov, and A. Yakobson (Iakobson). Translated by B. W. Kuvshinoff (Johns Hopkins Univ., Silver Spring, Md.) from Znanie-Sila, No. 11, (1960). 7p.

A general outline is presented of several methods for detecting flaws in light-opaque materials. An ultrasonic-pulse detector system is described that affords a television picture of the internal structure of the object under investigation. Attention is also given to x- and γ-ray inspection systems. Infrared microscopy methods, which are used primarily to inspect semiconductor materials, are also discussed. (T.F.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

4366 (AD-257178) APPLICATION OF WEATHER RADAR TO FALLOUT PREDICTION. Quarterly Technical Report No. 12, December 1, 1960–February 28, 1961. Pauline M. Austin (Massachusetts Inst. of Tech., Cambridge. Dept. of Meteorology). Mar. 15, 1961. Contract DA36-039-SC-75030. 16p.

Many intensity-contour records of winter-type storms were obtained. Preliminary analysis of these data has already commenced. Intensive maintenance work on the radar was required, not on account of breakdowns, however, but because of continued efforts to assess and improve the accuracy of quantitative data. Progress was made in recognizing possible sources of error and devising techniques for testing them. A detailed study of the structure of scattered intense convective storms which occurred on July 18, 1960 was undertaken. Rainout computations for a 10 KT detonation in a selected wind field are nearly complete. Some of the results are summarized. The whole series of computations will be repeated for a different wind field during the coming quarter. Excellent data on the scale of turbulence in widespread storms were obtained from the dual R-meters and are in process of analysis. (auth)

4367 (CEA-2004) ETUDE DES DIFFERENTS DEFLECTEURS UTILISES POUR LES CHEMINEES DE MARCOULE ET RECHERCHE D'UN NOUVEAU TYPE DE DEFLECTEUR. (A Study of the Various Baffles used in the Marcoule Chimneys and the Search for a New Model). J. Chassany (France. Commissariat a l'Energie Atomique. Centre de Production de Plutonium de Marcoule, Chusclan), H. Parigi (France. Institut de Mecanique des Fluides, Marseilles), and G. Salauen-Penquer (France. Centre National de la Recherche Scientifique, Paris). 1961. 14p.

The baffle placed at the top of a chimney determines the shape of the smoke pall for low exit-velocities. The G.1 type baffle was studied taking into account the characteristics of its collar: totally hollow, partially hollow, and solid; on a ribbed chimney or on a plain chimney. The Pu type baffle was also tested. The search for a new type of baffle was limited to variants of the bald-type baffle: a porous envelope device; a cone-shaped device; and a deflector of the cupel type. Only the blade-type baffle was rejected; efficient solutions are proposed using the other types or their combinations. (auth)

4368 (IA-565) RADIOGEOLOGICAL MEASUREMENTS IN ISRAEL. Emanuel Mazor (Israel. Atomic Energy Commission, Tel-Aviv). July 1960. 125p. (In Hebrew)

Results are reported for a radiogeological survey carried out in Israel from 1955 to 1959. The survey comprised gamma activity measurements on exposed rocks and gamma activity, radium, and radon measurements on water which gave an indirect indication of the radioactivity of deeper lying rocks. The rock data are expressed in terms of background units of radiation (b.g.u.), with cenomanium-turonian limestone as reference (10 b.g.u.). Attempts were made to correlate the radium and radon contents of water with each other and with temperature and other geological variables. (D.L.C.)

4369 (NRL-5692) FISSION PRODUCT RADIOACTIVITY IN THE AIR ALONG THE 80TH MERIDIAN (WEST) DURING 1960. L. B. Lockhart, Jr., R. L. Patterson, Jr., A. W. Saunders, Jr., and R. W. Black (Naval Research Lab., Washington, D. C.). Oct. 24, 1961. 18p.

Results are presented in a continuing study of radioactivity in air along the 80th meridian (West). The year 1960 brought progressive decreases in airborne fission product radioactivity though the rate of decrease with time was significantly less than during 1959. During 1960 the activity levels in the Northern and Southern Hemispheres gave indications of approaching equilibrium which suggested that transequatorial mixing in the stratosphere does occur but with a mean lifetime of several years for the process. However, two years after the cessation of the major nuclear test programs, differences in the fission product compositions of the two hemispheres still existed. The relatively small amounts of radioactivity generated by the French nuclear tests in the Sahara produced only transient effects at a few sites along the 80th meridian. The interpretation of atmospheric mixing patterns from measurements of the concentrations of the longer-lived fission products in the air was not significantly affected by these fresher debris. Fission product ratios involving some of the shorter-lived fission products did document the presence of debris from the February 1960 test in a band extending from Miami, Florida, to Grayaquil, Ecuador, with the suggestion that small amounts of debris did appear in other areas. (auth)

4370 (ONR-9(Vol.3)) NAVAL RESEARCH FIFTH NAVY SCIENCE SYMPOSIUM, APRIL 18, 19, 20, 1961, U. S. NAVAL ACADEMY, ANNAPOLIS, MARYLAND. (Office of Naval Research, Washington, D. C.). 407p. (AD-260241)

Twenty papers are presented from the symposium. Two of the papers are abstracted separately. The remaining 18 papers cover such topics as: oceanography, sea animal propulsion and acoustics, oceanic ducts, meteorology and meteorological effects on radio wave propagation in the trade-wind areas, performance of two-stage guns using pre-burnt propellant, the ground-cushion-effect machine, vented hydrofoils, high-performance ships, small water waves, hysteresis in Ba titanate, solid-state research, thin-film microelectronics, photoconductive infrared detectors, and frequency response of non-linear systems. (T.F.H.)

4371 (ONR-9(Vol.3)(p.801-11)) BEHAVIOR OF A 30-KEV SPACE-CHARGE-LIMITED ELECTRON BEAM INJECTED INTO HYDROGEN AT LOW PRESSURE. D. C. dePackh and P. B. Ulrich (Naval Research Lab., Washington, D. C.).

The current density distribution in a space-charge-limited beam of 30 kev electrons passing through H gas at pressures of about 10^{-5} to 10^{-3} mm Hg is measured as a function of H pressure. The measured distributions are reproducible at pressures up to about 10^{-4} mm Hg. (T.F.H.)

4372 (ONR-9(Vol.3)(p.1018-33)) NUCLEAR SUBMARINE HABITABILITY. Eugene A. Ramskill (Naval Research Lab., Washington, D. C.).

Major problems in controlling the atmosphere in nuclear submarines are indicated. Attention is given to detection and identification of the substances present in the atmosphere, determination of the concentrations and toxicities of these substances, determination of the sources of contaminants, and control of the concentration of harmful substances. (T.F.H.)

4373 (RME-4535(Rev.)) RECONNAISSANCE FOR URANIUM IN THE ANTOFAGASTA AREA, PROVINCE OF ANTOFAGASTA, CHILE. Paul H. Knowles, William A. Bowes, Mario Serrano C., and Rodolfo Gruenwald S. (Division of Raw Materials, AEC and Chile. Instituto de Investigaciones Geológicas, Santiago). Apr. 1961. 15p.

The Antofagasta area was examined for the possible occurrence of commercial deposits of uranium. Significant radioactivity was verified in the Sierra Gorda district about 140 km northeast of Antofagasta. This was noted in three sets of shears in an altered host rock of microgranite and granite. It was concluded that the Sierra Gorda district warrants at least some additional investigation due to the presence of moderately high radioactivity in strong vein structures cutting a granite which possesses abnormally high background radioactivity. (auth)

4374 (TID-13093) THE CIRCULATION OF THE STRATOSPHERE. Status Report, July 1, 1961. (Massachusetts Inst. of Tech., Cambridge). July 1, 1961. Contracts AT(30-1)-2242 and AF19(604)-5223. 10p.

Preliminary results of an investigation of the mechanics of circulation in the stratosphere are reported. Both axisymmetric and nonsymmetric flows are considered. Attention is devoted to the distribution and advection of total ozone; the momentum and energy balances in the stratosphere; vertical and horizontal movements; diurnal wind variations; and theoretical studies. (T.F.H.)

4375 (TID-14425) ATMOSPHERIC TRITIUM ANALYSIS. Technical Progress Report No. 3. Earl W. Barrett and Leonid Huebner (Chicago. Univ.). Nov. 27, 1961. Contract AT(11-1)636. 65p.

The sequence of measurements of tritium in Chicago precipitation was extended into the winter of 1960 to 1961. Precipitation sampling was augmented near the end of the period by samples of water vapor condensed directly from the ambient surface air by means of mechanical refrigeration equipment. The tritium contents of such condensed vapor samples agree to within the standard error of the measuring technique with the tritium contents of simultaneously occurring precipitation. This observation indicates that the rate of tritium equilibration between falling precipitation and ambient water vapor is fairly rapid. It was found, on the basis of the calculated parameters of a two reservoir model, and on the assumption of a mean value of 3 cm for the tropospheric precipitable water, that the total tritium content of the stratosphere at the beginning of November 1958 was 27.6 kg while that of the troposphere was 255 gm. The stratospheric burden was reduced to 1.66 kg by the end of October 1960 by transport to the troposphere and radioactive decay. The annual-mean rate of exchange of water vapor across the tropopause by all processes is calculated to be 7.6×10^{-3} cm of precipitable water. Assuming an annual-mean precipitation of 76 cm, this implies that one part in 10^4 of the rain that falls each year is water that has come from above the tropopause. An attempt to deduce the parameters of a three reservoir model through application of the method of least squares is described. (P.C.H.)

4376 (JPRS-10888) THE SEISMIC METHOD OF DETECTING AND IDENTIFYING NUCLEAR EXPLOSIONS. I. P. Pasechnik. Translated from Izvest. Akad. Nauk S.S.S.R., Ser. Geofiz., No. 6, 835-46(June 1961). 17p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27875.

4377 THE DISTRIBUTION OF STRONTIUM-90 AND CESIUM-137 AMONG VARIOUS ECOLOGICAL COMPONENTS. G. I. Makhonina, N. V. Timofeev-Resovskii, A. A. Titlyanova, and A. N. Tyuryukanov (Biophysics Lab., Urals Branch, Academy of Sciences, SSSR). Doklady Akad. Nauk S.S.S.R., 140: 1209-12(Oct. 11, 1961). (In Russian)

Aqueous solutions of Sr^{90} (10 mc) and Cs^{137} (15 mc) were percolated into 1 m^2 of soil through 81 openings 1, 5, 10 and 15 cm deep in order to obtain a uniform distribution of activity in the top, 15 cm layer of soil. The weight and activity in the biomass above ground and below ground, of the forest litter, and of the soil at depths of 0 to 15 cm, 15 to 20 cm, 20 to 25 cm and 25 to 30 cm were determined after the passage of three vegetative periods of growth. The biomass above ground contained 0.13 and 0.19%, and the roots of the underground biomass contained 0.11 and 0.13% of the total amount of Sr^{90} used on two different plots in the Il'menskii National Park in the South Urals. The accumulation of Cs^{137} is much smaller, 0.007% for the biomass above ground, and 0.011 to 0.021% for the root system. The litter was found to contain 0.5 to 3% of the total Sr^{90} and Cs^{137} activity. The accumulation of Sr^{90} and Cs^{137} by various plants is presented as the ratio of activity in the above-ground part of the plant to the concentration of activity in the root system, and as the ratio of activity of 1 gram of dry plant material to the activity in one gram of soil. On the average the accumulation of Sr^{90} by the plants is larger than of Cs^{137} by an order of magnitude. The ratio of activity in one gram of plant material to the activity in one gram of soil varies from 0.001 to 0.5 for Cs^{137}, and from 0.01 to 5 for Sr^{90}. This ratio is greater than one for Sr^{90} in 10 out of 16 plants tested. Pine and larch accumulate the least amount of Cs^{137} and Sr^{90} with a ratio of 0.01 for Cs^{137} and a ratio of 0.1 for Sr^{90}. The aspen (Populus tremula) shows a ratio of 0.01 for Cs^{137} and of 0.60 for Sr^{90}. Moss and mullein (Verbascum sp.) absorb Cs^{137} preferentially (activity ratio of 2 to 6 for mullein). The roots of the crowfoot (Ranunculus sp.), veronica, and legumes absorb Sr^{90} preferentially with an activity ratio of 5.4, 1.2 and 3.4 respectively. However, in general, Cs^{137} is adsorbed by the root system, and Sr^{90} by the above-ground part of the plant. (TTT)

4378 CHLORINE-36 AND DEUTERIUM STUDY OF GREAT BASIN LAKE WATERS. F. T. Bonner (State Univ. of New York, Long Island Center), E. Roth, O. A. Schaeffer, and S. O. Thompson. Geochim. et Cosmochim. Acta, 25: 261-6(Dec. 1961). (In English)

Chloride samples from the waters of Mono Lake, Pyramid Lake, and the lower Truckee River were examined by low-level counting techniques for chlorine-36 content. Chlorine-36 in the lake samples was found to be below the limit of detectability of the method, indicating a cosmic ray exposure age of less than 300000 years for the chloride examined. No detectable chlorine-36 was found in surface chloride samples from three separate salt-flat locations in Utah and Nevada. Significantly detectable chlorine-36 was found in the lower Truckee River sample and it is suggested that this activity has its origin in recent thermonuclear tests. Hydrogen–deuterium ratios were determined for Mono Lake, Pyramid Lake, Lake Tahoe, and associated streams. It is indicated that all three lakes lose water largely by evaporation, and that Lake Tahoe water has substantial residence time despite its outflow into the Truckee River. It is also indicated that the Truckee River is subject to strong dilution by fresh runoff water. (auth)

4379 GEOCHEMICAL VARIATIONS IN FOUR RESIDUAL SOILS. Nicholas M. Short (Univ. of California, Livermore). J. Geol., 69: 534-71(Sept. 1961).

Variations in concentrations of Si, Al, Fe, Mg, Ca, Na, K, and Ti (as oxides) and Ba, Co, Cr, Cu, Ga, Mn, Ni, Pb,

Sc, Sr, V, Zn, and Zr were determined by the mutual-standard method of spectrochemical analysis on the total soil and parent-rock samples, separated sand, silt, and clay fractions, and acetic acid leachates of soils developed from granodiorite (Wyoming), basalt (Colorado), granite (Missouri), and metamorphosed andesite (North Carolina). Intraplate precision is ±7.5%, interplate precision is ±28%. Particle-size distribution, the mineralogy of each size fraction and measurements of $-H_2O$, pH, Eh, soluble salts, free iron oxide, organic matter, and exchange capacity are related to composition by graphical and statistical methods. Conclusions are presented for the four soils: enrichment or depletion of most trace elements is directly proportional to the amount of clay and silt produced by weathering; the largest concentration changes occur across the parent rock-soil interface; Al-Ga, Fe-Co, Fe-Mn, Fe-Ti, Fe-V, and Mg-Sc show similar behavior during weathering; less definite associations are noted for Fe-Cu, Fe-Cr, Mg-Cu, Ca-Sr, K-Ba, and K-Pb; the B-horizon usually shows maximum enrichment in Co, Cr, Cu, Mn, Ni, Sc, Ti, and V and contains the largest leachable amounts of most elements; climate appears to be more important than parent-rock composition in affecting trace-element distributions; concentration changes of some elements are related to survival or destruction of certain parent-rock minerals; the only distinct differences in element content between the two salic and two mafic parentage soils are in the concentrations of Si, Fe, Cu, Sc, V, and Zr; and no clear-cut relation between minor element variations and pH, Eh, or free iron oxide values throughout a profile was found in any of the four soils. (auth)

4380 URANIUM IN THE SIKHOTE-ALIN METEORITE AND ITS RELATION TO THE LEAD METHOD OF AGE DETERMINATION. Edward L. Fireman (Smithsonian Astrophysical Observatory, Cambridge, Mass.) and David E. Fisher. Nature, 192: 644-5(Nov. 18, 1961).

To test the assumption that the excess of lead-206 is due to the radioactive decay of the isotope uranium-238, of lead-207 to that of uranium-235, and of lead-208 to that of thorium-232, a search was made for uranium-235 in the Sikhote-Alin meteorite, which is a meteorite that clearly has a lead-207 excess. Results showed less than 1.4×10^{-13} g/g of uranium-235, corresponding to less than 2×10^{-11} g/g of normal uranium. This amount is more than a factor of one hundred too small to account for the excess lead-207 in the Sikhote-Alin meteorite in 5×10^9 years. Thus, the uranium and lead contents of the meteorite are inconsistent with the common assumption made in determining lead ages for earth and meteorites. The assumption was that both contain lead isotopes of the same isotopic composition when the bodies were formed. The experimental method used is described. The lead-207 excess in the meteorite is 2.2×10^{-9} which would require 10^{10} years for this excess to result from 1.5×10^{-13} g/g of uranium-235. (N.W.R.)

4381 ISOTOPIC COMPOSITION OF ATMOSPHERIC HYDROGEN AND METHANE. A. E. Bainbridge (Scripps Institution of Oceanography, La Jolla and San Diego, Calif.), H. E. Suess, and Irving Friedman. Nature, 192: 648-9 (Nov. 18, 1961).

Tritium concentrations in atmospheric hydrogen and methane from 1948 to 1960 are discussed. The effects of artificial inactive hydrogen and methane on the isotopic composition of the atmospheric hydrogen and methane are also discussed. (N.W.R.)

4382 THE CRYSTAL CHEMISTRY OF THE URANIUM MINERAL DAVIDITE. B. Contag and H. Strunz (Technische Universitat, Berlin). Naturwissenschaften, 48: 597(1961). (In German)

The crystalline properties of davidite, a uranium-containing iron titanate, were determined and compared with those of ferutite. The lattice parameters were established, and the formula was calculated. (J.S.R.)

4383 RATIO OF THORIUM-230 TO THORIUM-232 IN DEEP-SEA SEDIMENTS. F. F. Koczy (Univ. of Miami, Fla.). Science, 134: 1978-9(Dec. 15, 1961).

The ionium-thorium method for age determination in deep-sea sediments is critically reviewed, and its shortcomings are discussed. A method that allows an estimate of the rate of sedimentation in the superficial layer of the sediment is presented. A formula for calculating the error in age determination by the method is given for the case when the rate of sedimentation is changing and, with it, the rate of Th^{232} sedimentation. (auth)

4384 THE URANIUM–VANADIUM ORE DEPOSIT AT THE MONUMENT NO. 1-MITTEN No. 2 MINE, MONUMENT VALLEY, NAVAJO COUNTY, ARIZONA. Irving J. Witkind (Geological Survey, Washington, D. C.). Geological Survey Bulletin 1107-C. 1961. 27p., 1 Illus. (GPO).

4385 GEOLOGY AND GEOCHEMISTRY OF URANIUM IN MARINE BLACK SHALES. A REVIEW. Vernon E. Swanson (Geological Survey, Washington, D. C.). Geological Survey Professional Paper 356-C. 1961. 49p. (GPO).

The geologic and geochemical investigations conducted during the period 1944 to 1957 on the amounts and distribution of uranium in black shales in the U. S. are reviewed, and geologic and geochemical information that directly or indirectly pertains to the origin and localization of uranium in marine black shale is evaluated. A graph is presented that shows the best estimates that can be made at the present time on the distribution and associations of uranium in marine black muds and shales. 159 references are included. (P.C.H.)

4386 CHEMICAL REACTIONS IN THE LOWER AND UPPER ATMOSPHERE. Proceedings of an International Symposium, San Francisco, California, April 18-20, 1961. New York, Interscience Publishers, 1961. 400p. $14.00

Twenty-five papers are given which were presented at a symposium on chemical reactions in the atmosphere. The topics treated include photochemical reactions, nitrogen oxides, hydrocarbons, sulfur oxides, organic compounds, pollutants, recombination of atomic oxygen, aurora, ionosphere, etc. A separate abstract for one of the papers is included under the category Chemistry-Radiation Chemistry and Radiochemistry. (D.L.C.)

4387 A COMPARATIVE STUDY OF RADIOLYSIS, PHOTOLYSIS, AND ELECTRON IMPACT DATA OF KETONES. J. N. Pitts, Jr. and A. D. Osborne (Univ. of California, Riverside). p.129-38 of "Chemical Reactions in the Lower and Upper Atmosphere." New York, Interscience Publishers, 1961.

A series of six ketones with interesting structural features was irradiated with 3-Mev gamma rays. Yields of product from these experiments were compared with vapor- and liquid-phase photolysis and electron impact (mass-spectrometric) data. Saturated straight-chain ketones, in analogy with their behavior under photolysis and electron impact, rearranged by the Norrish Type II mechanism to give acetone and the corresponding olefin. The unsaturated ketone and the cyclopropyl ketones gave low yields of product and this, too, is analogous to their photolytic behavior. Data for the ketones under the three kinds of irradiation are tabulated and discussed. (auth)

HEALTH AND SAFETY

Refer also to abstracts 4312, 4372, 4471, 4538, 4978, and 4983.

4388 (A/AC.82/G/L.691) CESIUM-137 LEVELS IN HUMAN BODY, AUGUST 1958–AUGUST 1960. Noboru Yamagata (Institute of Public Health. Radiation Health Lab., Tokyo). Aug. 1961. 13p.

Cesium-137 levels were determined in human bone and muscle samples from August 1958 to August 1960. Log normal distribution of Cs^{137} (and Cs^{137}/Cs^{133} ratio) was assumed in people instead of normal distribution. There were some cases in which extremely high values of Cs^{137} appeared. The incident of extremes seemed to be seasonal. This fact might suggest that there is some connection with the maximum fall-out rate observed in the same season of the year, and that the non-soil, direct contamination of vegetation and the short turnover time of Cs^{137} in man might cause the extremely high concentration. A brief discussion is given on the time dependence of the Cs^{137} levels in terms of cesium units as well as the isotopic ratio of Cs^{137} to Cs^{133}. The data are tabulated. (P.C.H.)

4389 (A/AC.82/G/L.693) NATURAL CONCENTRATION OF KRYPTON-85, CARBON-14, AND TRITIUM IN RECENT YEARS. Kunihiko Kigoshi (Gakushuin Univ., Tokyo). Aug. 1961. 4p.

Kr (10 to 50 ml) was collected at Tokyo from liquid oxygen obtained from a small-scale nitrogen liquefier. A remarkable increase in the concentration of atmospheric Kr^{85} after the middle of 1960 is shown. Atmospheric CO_2 was collected at Tokyo by absorption in NaOH solution, and the radioactivity was measured. Tree rings were analyzed for C^{14} and tritium concentrations. The concentration of C^{14} and of tritium in the tree ring are regarded as an annual mean value of the C^{14} concentration in the atmosphere and of the tritium concentration in rain water. The concentration of atmospheric C^{14} had a maximum value at the beginning of 1960, and the concentration of tritium decreased after 1959 with a half life of about one year. The data are tabulated. (P.C.H.)

4390 (BMI-1559) THE DEVELOPMENT AND EVALUATION OF SAFETY PERFORMANCE CRITERIA FOR SEALED RADIATION SOURCES. Charles W. Townley, Joseph M. Fackelmann, Charles L. Selander, Robert A. Ewing, and Duane N. Sunderman (Battelle Memorial Inst., Columbus, Ohio). Dec. 5, 1961. Contract W-7405-eng-92. 96p.

The current status of sealed radiation sources in the United States was surveyed as the first phase of a program to develop safety performance criteria for sealed sources. Information was accumulated on source applications, designs, fabrication techniques, and testing procedures. Existing regulations, specifications, and performance criteria were also surveyed, and this information was compiled and evaluated. Previous incidents involving sealed sources were reviewed, and source behavior was evaluated tentatively for conditions such as temperature and pressure extremes, mechanical shock, corrosion, and radiation damage. Potential hazards of sealed sources were considered, and a tentative classification system for sources was devised on the basis of the potential hazards. Establishment of safety performance criteria and definitive evaluations of source performance were not possible in the absence of experimental data. (auth)

4391 (CLOR-8) PERSONNEL FILM MONITORING SERVICE IN POLAND DURING THE YEAR 1960. T. Musiałowicz and J. Wysopolski (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centralne Laboratorium Ochrony Radiologicznej, Warsaw). June 1961. 12p.

The results of systematic measurements of individual doses carried out in laboratories during 1960 are presented. The results of the 21,661 determinations were analyzed according to the type of establishment and the age and sex of the employees monitored. The results were also compared with those of 1959. (auth)

4392 (CNI-95) MISURE DI RADIOATTIVITA AMBIENTALE–ISPRA 1960. (Measurements of Environmental Radioactivity–Ispra 1960). A. Anzani, A. Benco, G. Dominici, P. Gaglione, C. Gandino, A. Malvicini, and L. Vido (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Studi Nucleari, Ispra). July 1961. 52p.

The results of environmental radioactivity measurements effected by the Health Physics Division during 1960 are reported. Measurements of Sr^{90} and Cs^{137} concentration in food chains and in geographical waters were particularly considered. These values gave useful information on the ability of soft water fish to concentrate Sr^{90} and Cs^{137}. (auth)

4393 (HW-66309) PLUTONIUM CONTAMINATED INJURY CASE STUDY AND ASSOCIATED USE OF Na_4EDTA AS A DECONTAMINATING AGENT. R. H. Wilson and W. B. Silker (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 3, 1960. Contract AT(45-1)-1350. 5p.

A description is given of the treatment of a puncture wound sustained by an employee with a sliver of plutonium metal found to contain ~32.9 μc of Pu and weighing 0.497 mg. During the decontamination process, a 10% solution of Na_4EDTA was applied to the area from which the sliver was removed. Urinalysis for plutonium showed an erratic excretion rate with initial voiding results of 1068 dpm of Pu^{239}, which dropped rapidly to ~3 dpm after 24 hr for a single voiding. The Na_4EDTA was suspected to have caused an unusually high rate of absorption of the plutonium into the blood stream and increased the urinary excretion. A plutonium solubility experiment was performed to determine the possibility of Na_4EDTA causing the abnormally high rate of absorption into the blood stream. (B.O.G.)

4394 (HW-71203) EVALUATION OF RADIOLOGICAL CONDITIONS IN THE VICINITY OF HANFORD, JULY–SEPTEMBER 1961. I. C. Nelson, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 29, 1961. Contract AT(45-1)-1350. 28p.

An evaluation of radiological conditions in the vicinity of Hanford for the third quarter of 1961 indicated only minor differences in calculated environmental exposures as compared with 1960 and the first half of 1961. The principal Hanford source of exposure continued to be identified with radionuclides in reactor cooling water discharged to the Columbia River. For individuals who regularly drink Pasco sanitary water, ingest local fish and waterfowl, and consume produce from local farms, an intake of bone-seeking radionuclides was estimated at about 40% of that recommended by the National Committee on Radiation Protection and Measurements (NCRP) as maximum for continuous intake by persons in the neighborhood of controlled

areas. The dose to the GI tract from drinking Pasco sanitary water for the 12 months ending with September of 1961 was calculated as about 90 mrems, which amounts to 6% of the recommended maximum permissible limit. While not significant in terms of human exposure, fallout from nuclear detonations was clearly in evidence in September. (auth)

4395 (IDO-12019) ANNUAL REPORT OF HEALTH AND SAFETY DIVISION, 1960. (Idaho Operations Office. Health and Safety Div., AEC). Sept. 1961. 149p.

The performance of 11.8 million man hours of work resulted in one fatality, 19 disabling injuries, and an integrated exposure to 2,294 rem of total body penetrating radiation. Radiation was not a causative factor in any of the injuries experienced at the NRTS during the year. Wastes at NRTS contributed less than 10% of the internationally agreed level of exposure acceptable to the off-site population. Contamination of the environment was controlled to such a degree that it has never been necessary to use extraordinary means to filter the water or intake air for occupied areas of any of the facilities. Other detailed information is included concerning the activities in the analysis, ecology, and site survey branches. The principal operational activities and research accomplishments of the Weather Bureau are also presented. (J.R.D.)

4396 (NAA-SR-Memo-5238) REMOVAL OF A RADIOACTIVE PRIMARY SODIUM PUMP OR A RADIOACTIVE PRIMARY COLD TRAP. P. J. Mallon (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 2, 1960. Contract [AT(11-1)-Gen-8]. 7p.

Methods and procedures are described for removing a radioactive primary sodium pump or a primary cold trap with handling casks from the Hallam Reactor. (D.L.C.)

4397 (NADC-MA-L6035) EYE PROTECTION FOR NUCLEAR WEAPONS DELIVERY PILOTS, INFLIGHT RESEARCH STUDIES TO OBTAIN QUANTITATIVE PERFORMANCE DATA. Progress Report. J. H. Hill and G. T. Chisum (Naval Air Development Center. Aviation Medical Acceleration Lab., Johnsville, Penna.). Sept. 21, 1960. 13p. (AD-257372)

A statistical analysis is presented of data collected in the determination of the degree of ability of pilots to continue an operational mission when blinded for periods of time up to 15 seconds. The influence of the subject pilot, check pilot, light conditions, and attitudes on the results are described. (B.O.G.)

4398 (NP-10713) OCHRONA RADIOLOGICZNA W MEDYCYNIE. (Radiological Protection in Medicine). (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej, Warsaw). 1961. 131p.

A handbook is presented for the application of nuclear phenomena and techniques to medical diagnostics and treatment. A large portion is devoted to fundamental nuclear chemistry and physics, paying special attention to tracer techniques. In addition to principles of dosimetry the government regulations applicable to medical exposures are described together with a survey of the field of health physics. (TTT)

4399 (NP-10738) BIBLIOGRAPHY ON FILMBADGE MONITORING. Herbert R. Isenburger (Saint John X-Ray Lab., Califon, N. J.). Nov. [1961]. 15p.

A bibliography on film-badge monitoring is presented. Two hundred and thirty-five references are given. Author and subject indexes are included. (M.C.G.)

4400 (NP-11116) SOME MAXIMUM HAZARD CONSIDERATIONS FOR REGIONS DOWNWIND OF A 10^4 MW NUCLEAR REACTOR DISASTER. W. H. Harless and J. P. Scheiwe (Douglas Aircraft Co., Inc., Santa Monica, Calif.). July 1960. 54p. (SM-36000)

A hazards study was conducted for a hypothetical incident involving the static test of a 10,000-Mw reactor. Two cases were considered. In the first case, the reactor core was assumed to have been vaporized at a height of 18 feet above ground level with the resulting isotope-bearing cloud traveling downwind at this height. In the second case, the cloud was assumed to have risen to 1,000 feet from thermal buoyancy and then traveled downwind at this altitude. A ground observer remaining a fixed distance directly downwind of the vaporized reactor was considered to absorb radiation dosages directly from external radiation and indirectly through inhalation of radioactive isotopes. The results indicate a potential hazard out to a downwind distance on the order of tens of miles. Because of the distances involved, it is recommended that pertinent topographical and meteorological data be included in a further analysis directed toward the study of a few real launch or test sites. (auth)

4401 (NP-11140) AN EVALUATION OF THE NEED FOR FILTRATION SYSTEMS FOR PROTECTION OF PERSONNEL IN STRUCTURES AGAINST THE ACUTE HAZARDS OF RADIOACTIVE CONTAMINATION OF THE ATMOSPHERE. (Naval Reserve Research Co. 3-9, Upton, N. Y. and Brookhaven National Lab., Upton, N. Y.). 1960. 41p.

The various types of events which may lead to atmospheric contamination are reviewed briefly, and the hazard of internal absorption of radioactive particles is evaluated. Recommendations are presented for air filtration systems and alarm systems. It is concluded that air filtration probably would not be needed in uncrowded basement shelters, provided ventilation systems are turned off and doors and windows are closed for 24 hr after the nuclear event. However, some form of ventilation would be necessary for closed underground shelters and special types of buildings. (D.L.C.)

4402 (NP-11142) DETECTION AND MEASUREMENT OF RADIOACTIVE CONTAMINATION. D. J. Carswell and J. H. Green (New South Wales, Australia. Univ., Kensington. Inst. of Nuclear Engineering). Apr. 1960. 51p. (INE-M4)

Summaries of lectures and experimental instructions on the detection and measurement of radioactive contamination are presented. The topics discussed include atomic structure and radioactivity; nature and properties of α, β, and γ rays; chemical and biological nature of possible contamination; health safety factors and agreements; gas ionization detectors; scintillation detectors; radiation dosage, measurement of external radiation dose, and permissible levels; low-level counting and assay; waste disposal and recommendations for permissible contamination levels; and complete instrumentation for survey monitoring and accurate counting of samples. The following experiments are described: Geiger tube characteristics; relative range and penetration of α, β, and γ radiation; penetration of γ radiation through various materials; relative efficiencies of counters for β-detection; inverse square law and calibration against a radium standard; and decontamination of contaminated water. (M.C.G.)

4403 (NP-11153(Vols.I and II)) FINAL HAZARDS SUMMARY REPORT FOR BIG ROCK POINT PLANT. VOLUME I. PLANT TECHNICAL DESCRIPTION AND SAFEGUARD EVALUATION. VOLUME II. PART I. ENGINEERING DRAWINGS. PART II. TOPICAL REPORTS.

(Consumers Power Co., Jackson, Mich.). Nov. 14, 1961. 387p.

A plant description and safeguard evaluation for the Big Rock Point Nuclear Plant is presented. In Vol. I, plant site and environment, containment, reactor, reactor system equipment, power system equipment, instrumentation, nuclear and thermal characteristics, waste disposal, research and development, operating procedures, safety analysis, and maximum credible accident are discussed. In Vol. II, engineering drawings are presented and meteorology, geology, hydrology, and seismology are discussed. (M.C.G.)

4404 (TRG-Report-25) GUIDANCE IN THE SAFE HANDLING OF ALKALI METALS. A. Thorley and A. C. Raine (United Kingdom Atomic Energy Authority. Reactor Group, Culcheth, Lancs, England). May 4, 1961. 19p.

A brief summary of chemical reactions of sodium with gases and some common reagents is given. To ensure maximum safety and confidence in dealing with liquid metals, advice is given on such topics as handling, cleaning of apparatus, and sodium disposal. For the information of emergency teams, sections on hazards, protective clothing, fire prevention, fire fighting, and first-aid are also included. The Siebe Gorman self-contained breathing apparatus is described in the appendix. (P.C.H.)

4405 (UCLA-455) X-IRRADIATION PROTECTION STUDIES. I. DOSE RATE EFFECT AND STATISTICAL DETERMINATION OF SIGNIFICANCE IN SURVIVAL TIME CURVES. James L. Leitch (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Mar. 7, 1960. Contract AT(04-1)-GEN-12. 17p.

To evaluate the applicability of survival time curves (time-effect curves) to the problem of radiation mortality studies, female DAL-Swiss mice were exposed to 460-471 r of whole-body x irradiation. The survival time curves were analyzed by the graphical method. The dose rate (r/min) was also varied in some experiments. It was shown that normal variations in survival curves from untreated but x-irradiated mice necessitate that statistical analyses be made at a probability level of $p = 0.02$ rather than at the less restricted level of $p = 0.05$. It was also found that the survival curves are significantly different ($p = 0.02$) for irradiation rates of 8.5—9.0 versus 19.4 r/min, respectively, even though the 60-day mortalities are practically the same. When compared at a level of $p = 0.02$, it seems that the survival curves under the conditions of these experiments are a satisfactory basis for the comparison of radiation mortalities. (auth)

4406 (UCRL-6654) A STUDY OF DESIGN AND COST DATA FOR FAMILY AND SMALL-GROUP FALLOUT SHELTERS. (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 10, 1961. Contract W-7405-eng-48. 49p.

A study of five durable family and small-group fallout shelter systems showed that three of them can be provided by individual labor and with austere accommodations for about $1200 to $1650, equivalent to a unit cost of about $200 per person. On the same basis, the two other designs cost somewhat more either totally or per person. Contracting for and commodiously outfitting these shelter systems approximately doubles the costs. A less desirable but satisfactory shelter can be put in, using Class B concrete pipe, for about $800 on a do-it-yourself basis. The shelters were designed so that the size can be increased in one direction with relatively small incremental cost. The systems were divided into component packages, which can be selected at will to yield shelters of varying degrees of livability. Design, excavation, and price data are included for the convenience of those who wish to build their own systems. (auth)

4407 (UCRL-9657) THE WATER-SHIELDED CAVE FACILITY FOR TOTALLY ENCLOSED MASTER-SLAVE OPERATIONS AT LAWRENCE RADIATION LABORATORY. Patrick W. Howe, Thomas C. Parsons, and Leonard E. Miles (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 9, 1961. Contract W-7405-eng-48. 33p.

An efficient, flexible, and relatively simple system of enclosures for the handling of multicurie amounts of alpha, gamma, and neutron-emitting isotopes has been developed by the Health Chemistry Department at Lawrence Radiation Laboratory, Berkeley. It has been in operation since April 1961. This system consists basically of interlocking 4-ft water tanks that form the shielding around the leaktight primary enclosure in which operations are conducted by means of totally socked master-slave manipulators. This facility has been successfully used for procedures ranging from multicurie chemical separations to highly refined microtechniques. It has served equally well for metallurgical examinations and remote machining and welding procedures. The cost of this totally equipped facility was approximately $60,000. (auth)

4408 (AEC-tr-4515) LIABILITY AND INSURANCE OF THE ATOMIC RISK IN THE EUROPEAN LAW SYSTEMS. A translation of thesis "Responsabilite et Assurance du Risque Atomique dans les Droits Europeens." Marie-Claire Camier (Dijon, France. Université). 1960. 166p.

A study of comparative law was undertaken to study problems relating to the risk and liability that might derive from the production, storage, operation, utilization, and disposal of various materials of nuclear origin, and also problems relating to the insurance of this liability. Instead of a theoretical study, which would describe what to do ideally in an ideal case, an attempt is made to present an exposé of current proposals on the national and international plane. Nuclear energy is considered only from the viewpoint of its peaceful utilization, but the fact remains that this usage involves a certain amount of damages. These damages are studied in the event of paying indemnities, should they occur. Next, a study was made of the problems of liability, including the means of compensation and the establishment of responsibility. Finally, referring to financial protection, responsible persons are shown how to protect themselves from the consequences of their obligation to pay compensation for these damages. 86 references are given. (P.C.H.)

4409 (JPRS-10595) RADIOACTIVE POLLUTION OF HUNGARY'S SURFACE WATERS. Laszlo Geal. Translated from Hidrol. Kozlony, 41: 266-8(June 1961). 6p.

The natural and artificial sources of radioactivity in the surface waters of Hungary are described, and the α and β activities of the water are measured at 153 locations over a 4-year period. The average β activity is 0.01 to 0.02 $\mu\mu$c/ml, and the α activity is on the same order of magnitude. (T.F.H.)

4410 (JPRS-10980) THE PROTECTION OF AGRICULTURAL ANIMALS FROM AERIAL ATTACK CONDITIONS. V. M. Isachenko. Translation of p.1-64 from "Zashchita Sel'skohozyaystvennykh Zhivotnykh v Usloviyakh Napadeniya s Vozdukha," Moscow, 1960. 58p.

Methods of protection of farm animals in areas of compound contamination that may occur as a result of atomic, bacteriological, and chemical weapons are discussed.

Topics covered include organization of the protection of farm animals, functions of veterinary units and inhabitants, protection of animals from the various weapons, veterinary treatment of animals, and organization of work of personnel of veterinary aid groups relating to elimination of contaminated areas. (M.C.G.)

4411 AEROSPACE NUCLEAR SAFETY. J. A. Connor, Jr. Aerospace Med., 31: (10) (I), 797-806(1960).

The use of nuclear power offers realistic vistas of interplanetary travel, colonization of other planets, and space security operations and makes it economically feasible, but holds the possibility of injecting additional radioactivity into the atmosphere. The basic principle used in aerospace programs is the conversion of nuclear heat to propulsive and/or electric power. In the design of nuclear powered aircraft, allowance must be made for the amount of shielding which must be carried to provide adequate protection for the crew. The designer must consider a crew compartment, shield size and weight, and a reactor shield, size and weight. Aerospace nuclear safety is discussed in relation to nuclear and flight technology and health considerations. (Public Health Eng. Abstr., 41: No. 11, 1961).

4412 ULTRASONIC CLEANING OF RADIUM APPLIANCES. A. Sivyer (Queen Elizabeth Hospital, Birmingham, Eng.). Brit. J. Radiol., 34: 817-18(Dec. 1961).

The use of ultrasonic waves for cleaning radium containers is described. Percentage of intercepted sound energy reflected is proportional to the size of the object cleaned. Assessment of the cleaning method was made empirically. No tendency for the radium salt to pack down during ultrasonic irradiation was found. The method also greatly assists sterilization by conventional methods. (L.N.N.)

4413 DESCRIPTION OF AN APPARATUS FOR THE DETECTION AND MEASUREMENT OF EXTERNAL PERSONNEL CONTAMINATION. J. Morichère and R. Nicolai. Bull. inform. sci. et tech. (Paris), No. 54, 2-10(Sept. 1961). (In French)

The apparatus described for the detection and measurement of external contamination was designed essentially from a practical point of view so that it may be operated by unskilled persons. Its characteristics are such that other applications for it will be found both in medical and scientific fields. Illustrations are also given of the apparatus. (P.C.H.)

4414 INCREASE OF ATMOSPHERIC TRITIUM FROM THERMONUCLEAR EXPLOSIONS. Roland Bibron, Georgette Delibrias, and Jacques Labeyrie. Bull. inform. sci. et tech. (Paris), No. 54, 11-15(Sept. 1961). (In French)

Tritium in precipitation and in the free hydrogen of air in France was measured since November 1958. These contents were, in spring of 1960, about 150 tritium units in rain and about 4×10^5 tritium units in free hydrogen. Results were obtained by liquid scintillation counting with a preliminary electrolytic enrichment for the samples of lower tritium contents. (P.C.H.)

4415 MEASUREMENT OF AIR ACTIVITY DUE TO KRYPTON-85. Georgette Delibrias, Marie-Thérèse Perquis, and Jacques Labeyrie. Bull. inform. sci. et tech. (Paris), No. 54, 16-18(Sept. 1961). (In French)

The activity of the air due to Kr^{85} rejected by the factories treating nuclear combustibles and by atomic explosions has been measured in France since 1958. After a regular increase of this activity until March 1959, an important decrease was observed, followed by a rapid augmentation since March 1960. (P.C.H.)

4416 THE RADIATION BURDEN OF PATIENTS IN X-RAY DIAGNOSTIC INVESTIGATIONS. M.-L. Arnal and H. Pychlau (Allgemeine Krankenhaus St. Georg., Hamburg). Fortschr. Gebiete Rontgenstrahlen u. Nuklearmed., 95: 323-35(Sept. 1961). (In German)

An account is given of a large-area ionization chamber which offers the possibility of measuring the dose applied to the patient during fluoroscopy and the area of incidence at the same time. The term "incident area-dose", expressed in $r \times cm^2$, is chosen for the measured product of dose and area. The incident area-dose for different x-ray examinations is assessed from values used by six diagnosticians and is listed in tables. From this procedure interesting conclusions on the working method of the particular diagnostician can be drawn. At the same time the relationship of the radiation burden to the patient incurred during fluoroscopy and during radiography is taken into account as well as the fraction which the radiographic dose bears on the total dose during an examination; this fraction has been found to be between 16 p.c. and 30 p.c. An attempt is being made to assess the area-dose with respect to the regulations on protection. The possibility is also discussed of working out the volume-dose in roentgen-liters with the help of the area-dose. The problems which attain to the indication of the total energy absorbed in the body in rad × kg are also considered. For the sake of comparability of the measurements obtained by different authors it is proposed to indicate the incident area-dose in $r \times cm^2$. (auth)

4417 TRANSFER OF STRATOSPHERIC FISSION PRODUCTS INTO THE TROPOSPHERE. D. H. Peirson (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nature, 192: 497-500(Nov. 11, 1961).

Evidence relevant to the transfer of fission products from the stratosphere to the troposphere are presented. Data are included on mixing between fission products from the polar stratospheric injections at 75°N in October 1958 and from earlier injections, in particular from equatorial injections at 11°N about June 1958. Variations of fall-out parameters with latitude, time, and altitude are discussed. (C.H.)

4418 ROLE OF THE VETERINARIAN INSPECTOR OF MEATS AND OF THE LABORATORY OF ALIMENTARY HYGIENE IN THE ATOMIC PROBLEM. Jean Morre. Rec. méd. vét., 136: (2), 101-8(1960).

Principles of supervision of areas liable to contamination and control of food, external and internal contamination, role of the veterinary surgeon in connection with the laboratory for radiological detection, and maximum permissible amount of contaminating radioactive products are discussed. Non-perishable foods exposed to radiations are not necessarily unfit for human consumption. They may be stored until radioactivity has sufficiently decreased. Tables are given concerning the fission products, the activity (in Mc) after the explosion, and the maximum permissible amount of contaminating radioactive products in the water after an atomic explosion. (Public Health Eng. Abstr., 41: No. 11, 1961).

4419 RADIATION PROTECTION IN THE CONSTRUCTION OF A COBALT-60 TELETHERAPY INSTALLATION. Elmar Schnepper (Universität, Munster, Ger.). Strahlentherapie, 116: 138-47(Sept. 1961). (In German)

A report is made about the radiation protective measures taken in the telegammatherapy department of the surgical university clinic in Münster and particularly of the building measures, necessary wall thicknesses of a built-in entrance labyrinth, and the protective arrangements and safety meas-

ures. The measurement of place and person dosage show that an increased radiation charge of the service personnel and those persons who are occasionally present in the control area can be avoided by well-built protective measures, in spite of the maximal running time of the Co^{60} apparatus. (auth)

4420 INVESTIGATIONS ON THE GONAD BURDEN IN THE X-RAY THERAPY OF NON-TUMOROUS DISEASES. Jaroslava Jakoubková, Milos Lokajícek, and Vladimir Stasek (Charles Univ., Prague). Strahlentherapie, 116: 148-51(Sept. 1961). (In German)

The authors examined the gonad charge in the x-ray therapy of nontumorous diseases through the correlation of values from measurements on patients and on a water phantom, the women being measured in the vagina and the men on the surface of the scrotum. The gonad dose attained high values in the radiation of the hip-joint and the lumbosacral vertebral column; in the radiation of the remaining parts it was essentially lower. For orientation purposes of the real gonad charge in the radiation of nontumorous diseases a documentation analysis was carried out in two radiotherapeutical faculty departments. It was ascertained that in the course of a year 0.77% of the population of four suburbs in Prague were x rayed on account of nontumorous diseases. In persons of a reproductive age doses were attained, which could lead to a somatic damage only occasionally. However, when one considers the cumulative ray effect, lower doses may not be neglected, especially with young people. (auth)

4421 DIE GENETISCHE BELASTUNG DER BEVÖLKERUNG EINER GROSSSTADT (HAMBURG) DURCH MEDIZINISCHE STRAHLENANWENDUNG. (The Genetic Burden of the Population of a Large City (Hamburg) from Medical Radiation Use). H. Holthusen, H.-K. Leetz, and W. Leppin. No. 21 of "Schriftenreihe des Bundesministers für Atomkernenergie und Wasserwirtschaft. Strahlenschutz. Munich, Gersbach & Sohn Verlag, 1961. 210p. DM 8.

The statistical collection of data on information on the radiation dosage to the gonads from medical radiation uses is presented. The genetic significance of gonadal doses and the manner of their calculation are discussed. Doses from dental x rays, and diagnostic and therapeutic uses of x rays were calculated. Methods of determining the gonadal dose from these x rays is discussed. The genetically significant yearly gonad dose in Hamburg in 1958 was determined and compared with other results. A comparison was also made of the per-capita-dose and the 30-year dose with genetically significant yearly gonad doses. Precautions that can result in a reduction of the doses are listed. (M.C.G.)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

4422 (MND-2584) RADIOISOTOPE SEMICONDUCTOR AND THERMOELEMENT RESEARCH AND DEVELOPMENT QUARTERLY PROGRESS REPORT NO. 1, FEBRUARY 13 TO MAY 31, 1961. J. B. Weddell (Martin Co. Nuclear Div., Baltimore). June 27, 1961. Contract AT (30-1)-2698. 66p.

Progress is reported in the development of materials, composed principally of strontium titanate in which the decay energy of strontium-90 contained in the material is converted to electrical energy. The conversion is accomplished in part by the Seebeck effect, with the unevenly distributed strontium-90 serving as a heat source within the thermoelectric titanate material. In addition, the beta particles emitted by the radioactive isotope create secondary electrons and holes which are accelerated in potential gradients associated with the concentration gradient of the decay product of the strontium-90. Thermodynamic equations of the transport of electrical charge and heat in an anisotropic semiconductor have been derived. The diffusion equation of secondary electrons introduced by beta irradiation has been set up. Specimens of strontium titanate, containing additions of iron, molybdenum, tungsten, ferric nitrate, and ferric oxide-titanium oxide have been produced by sintering in hydrogen at temperatures between 1400 and 1475°C. The thermoelectric properties of these materials have been measured. Material composed of 58.6 at.% strontium titanate and 41.4 at.% iron powder has a thermoelectric figure of merit of 6.8×10^{-4} deg^{-1} C at a temperature of 900°C and has been selected as the basic material for further development. (auth)

4423 (NYO-9848) UTILIZATION OF RADIOACTIVE ISOTOPES IN COAL PROCESS RESEARCH. 9th Quarterly Technical Status Report, June 1, 1961–August 31, 1961. P. M. Yavorsky and E. Gorin (Consolidation Coal Co. Research and Development Div., Library, Penna.). Oct. 1, 1961. Contract AT(30-1)-2350. 19p.

The experimental technique was checked out and the equipment put in working order for the study of the capacity and efficiency of the hydraulic cleaning of coal by water fluidization. The method to determine operating capacity consists of determining the segregation rate by dynamic tracing of radioactive mineral impurities of various size and density ranges, that are injected into the fluidized bed of coal. The equilibrium position of the injected tracer in the fluidized bed of solids is also determined. Obtaining capacity and efficiency data, as needed for design of commercial units, is very much less expensive and much more rapid than operation of a continuous flow pilot plant to get the same data. The required tracer solids were prepared by neutron irradiation of selected fractions of mineral impurities and the experimental work with these tracers is now in progress. (auth)

4424 (TID-8537) STATUS OF THE APPLICATION OF NUCLEAR REACTORS IN THE PROCESS INDUSTRIES. (Division of Reactor Development, AEC). 1961. 136p.

A market survey and an analysis of the state of development of applications of nuclear reactors in the process industries is presented. Four areas of application, which satisfy individual markets and lie in distinct technological classes, are considered. These areas are: low-temperature process heat (below 400°F); high-temperature process heat (above 1500°F); neutron, β, and γ ionizing radiations; and fission-fragment chemonuclear reactions. (T.F.H.)

4425 (AERE-Trans-877) THE MANUFACTURE, PREPARATION AND SALE OF RADIOACTIVE ISOTOPES. J. J. Arlman. Translated by J. S. Mills (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Atoomenergie, 2: No. 10, 162-72(1960). 23p.

A review is presented of the various aspects involved in the manufacture of radioisotopes for sale. Both reactor and cyclotron irradiations are considered. (D.L.C.)

4426 (OTS-61-21970) ON THE USE OF RADIOACTIVE INDICATORS IN THE STUDY OF REACTIVE DIFFUSION. A. A. Zhukhovitskii (Zhukhovitskiy) and A. D. Sotskov. Translated from Nauch. Doklady Vysshei Shkoly, Met., No. 1, 211-17(1958). 11p.

A discussion is given of the development, on the basis of tagged atoms, of a technique for investigating reactive diffusion and its application to simple cases. Additional requirements raised in the study of reactive diffusion, as compared with ordinary diffusion, include the determination of the characteristics of the kinetic and diffusion stages of the rate of topochemical process, the rate of growth of disappearance of a phase, and structural diagrams. Microstructural analysis is considered the simplest method of studying the rate of reactive diffusion, but the accuracy of the method is poor as a rule, even in the case of equal boundaries of phases. (B.O.G.)

4427 THE AECL RADIOISOTOPE APPLICATIONS HANDBOOK. (Atomic Energy of Canada Ltd. Commercial Products Div., Ottawa). [1961]. 54p. (AECL-1396)

The practical and potential uses of radioisotopes are listed and described. Non-destructive testing, measurement and control, industrial radiation processing, sterilization of drugs and hospital supplies, radiation preservation of food, radioisotopes in agriculture, radioisotopes in scientific research, radioisotopes in medicine, and other applications are discussed. (M.C.G.)

ISOTOPE SEPARATION

4428 (JPRS-11213(Pts.I and II)) THEORY OF ISOTOPE SEPARATION IN COLUMNS. Adrian Mikhaylovich Rozen. Translation of p.3-438 from "Teoriya Razdeleniya Izotopov v Kolonnakh" (A publication of the Publishing House of the State Committee of the Council of Ministers USSR on the Utilization of Atomic Energy, Moscow, 1960). 567p.

A book is presented in which the basic methods of countercurrent separation and the principles of separation in columns and column cascades are treated in detail. Distillation, isotope exchange, thermal diffusion, mass diffusion, and centrifugation are considered. A unified approach to various processes is used to facilitate understanding. Finally, applications of theory to engineering practice are discussed. (D.L.C.)

4429 CHROMATOGRAPHIC SEPARATION OF RADIONUCLIDES BY MEANS OF AMMONIUM MOLYBDATOPHOSPHATE ON PAPER CARRIER. H. Schroeder (Kernforschungszentrum, Karlsruhe, Ger.). J. Chromatog., 6: 361-3(Oct. 1961). (In German)

An attempt was made to separate carrier-free fission products and radionuclides with and without carriers in low concentrations and small volumes for the purpose of identification using ammonium phosphomolybdate absorbed on paper. Ce^{137} was separated from Sr^{90}, Ce^{144}, and Ru^{106}. A mixture of Cs^{137}, $Sr^{90}-Y^{90}$, and $Ce^{144}-Pr^{144}$ was separated. Ag and Pd were also separated by this method. (M.C.G.)

MATHEMATICS AND COMPUTERS

4430 (ANL-6453) APPLIED MATHEMATICS DIVISION SUMMARY REPORT, JULY 1, 1960 THROUGH JUNE 30, 1961. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 65p.

Progress is reported on research in applied mathematics, theory and practice of computation, design of computers and information processing equipment, providing mathematical consultation, and operation of a computational service, using both digital and analog machines. Topics discussed include computer programs; programming systems and library routines; computer engineering and equipment; publications and papers; seminars, lectures, and courses; and computer services. (M.C.G.)

4431 (ANL-6456) ELEMENTARY DIVISORS AND SOME PROPERTIES OF THE LYAPUNOV MAPPING $X \rightarrow AX + XA$. Wallace Givens (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 81p.

A study is presented in which the primary emphasis is placed on establishing easy and convenient techniques for a further study of the Lyapunov mapping and in which completeness is uniformly preferred to brevity. (J.R.D.)

4432 (CEA-2007) PRINCIPE DE L'ALGEBRE DE BOOLE ET DES METHODES DE SYNTHESE DERIVEES EN VUE DE LEUR APPLICATION AUX AUTOMATISMES DESTINES A LA SECURITE DES PILES ATOMIQUES. (Principle of Booles Algebra and Synthetic Methods Derived with a View to Their Automatic Safety Applications in Atomic Piles). Jacques Furet (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). 1961. 61p. (SAER-1409/930)

Since automation development is important from the safety point of view in reactor control, it is essential to use the most reliable methods possible in the design of shutdown circuits. The theorems of Boolean algebra are outlined, and several methods for optimizing these theorems are reviewed. The application of the theorems to several practical examples is shown. A review is given of one-entry circuits having several exits, and of circuits whose logical function is symmetric, assuming that the time factor does not intervene during operation. (auth)

4433 (CF-61-5-54(Rev.)) IBM 7090 GAUSSIAN INTEGRATION ROUTINES. M. B. Emmett and S. K. Penny (Oak Ridge National Lab., Tenn.). Dec. 6, 1961. Contract [W-7405-eng-26]. 9p.

Three Gaussian integration routines, GINT1, GINT2, and GINT3 were written in FAP and made compatible with the ORGDP Monitor System and its Error Trace Routine. They were written for use with Fortran programs and subroutines. A sample problem is included. (M.C.G.)

4434 (CNEN-64) IL LINGUAGGIO ALGORITMICO "ALGOL" PER I CALCOLATORI ELETTRONICI. (Programming Language "Algol" for Electronic Computers). Translated into Italian. A. J. Perlis and K. Samelson (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Aug. 1961. 38p.

The increasing diffusion of electronic computers and the variety of existing programming languages induced the Association for Computing Machinery (U.S.A.) and the GAMM Association (Germany) to elaborate a universal programming language, the Algol. An Italian translation of the Algol is given. (auth)

4435 (CNEN-65) IL LINGUAGGIO "ALFO", RIDUZIONE DELL'ALGOL PER L'I.B.M.-650. (Alfo Language: Algol Reduction for IBM-650). Translated into Italian. H. Schappert (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Aug. 1961. 13p.

The algebraic language ALGOL was adopted for use with IBM-650. (auth)

4436 (CNEN-88) PSEUDO-RANDOM SEQUENCES OF EQUAL LENGTH. A. De Matteis (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Calcolo, Bologna) and B. Faleschini (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Aug. 1961. 18p.

When a pseudo-random sequence is generated by the congruential multiplicative method, its period is the exponent to which the fixed multiplier belongs for a given modulus. The properties of the numbers belonging to the same exponent are investigated. They permit one to obtain the set of such numbers by simple operations of congruence, starting from a minimal subset. (auth)

4437 (CNI-96) SERVIZIO CALCOLO ANALOGICO. SOMMARIO DEI METODI DI LAVORO E DELLE APPARECCHIATURE. (Analog Computation Service. Summary of Methods and Apparatus). (Italy. Comitato Nazionale per l'Energia Nucleare, Ispra). Mar. 1961. 12p.

Some of the problems solvable by analog computers are described. The equipment of the Analog Computation Service Laboratory of the CNEN is listed. (D.L.C.)

4438 (D1-82-0051) VECTOR INTEGRAL EQUATIONS. R. A. Gerwin, J. E. Drummond and B. G. Springer (Boeing Scientific Research Labs., Seattle). Aug. 1961. 182p.

The theory of simultaneous integral equations is discussed. Emphasis is placed on vector integral equations which may arise from mathematical analysis of physical situations in which both vector properties and integral properties are important, such as ionized gases acted upon by electric and magnetic fields. In this case the physical situation is described by Maxwells' equations for the electromagnetic fields, and by the matter equations for ionized gas. It is shown that it is not necessary to change a set of simultaneous integral equations into a single scalar integral equation by means of a complicated redefinition of the functions involved. Matrix multiplication is used as a convenient bookkeeper for the iterated kernels, and changing into a vector integral equation allows the use of a method suitable for programming the iteration procedure. A few fundamental theorems of function theory are used, and the references for these theorems are listed. (C.H.)

4439 (D1-82-0079) ON THE CLASSICAL CLUSTER INTEGRAL THEORY OF FLUIDS IN EXTERNAL FIELDS. Report No. 35. Russell V. Hanks (Boeing Scientific Research Labs., Seattle). Nov. 1960. 27p.

Cluster integral expansions of the classical grand ensemble partition function, and singlet and pair distribution functions of fluids in external fields are discussed. Certain topological properties of terms occurring in the pair distribution function are examined and used to derive an exact integral equation for a subset of these terms. Approximations which form the activity-dependent analogues of the chain and series-parallel approximations are obtained from this equation and discussed. The thermodynamic

properties of a classical single component electron gas in a homogeneous electric field are also calculated. (auth)

4440 (D1-82-0105) NUMERICAL ANALYSIS AND RELATED LITERATURE FOR SCIENTIFIC COMPUTER USERS. Mathematical Note No. 241. James F. Price (Boeing Scientific Research Labs., Seattle). May 1961. 143p.

A bibliography is presented on numerical analysis and related literature for scientific computer users. The journal articles included are those published in 1958 to 1961. Seventy-one books are reviewed. The references include 428 journal articles. No foreign language references are given. A subject index is presented. Methods of looking up given subjects in the literature are discussed. (M.C.G.)

4441 (GAMD-1581) IBM 650 CODE FOR COMPUTING INFINITE MEDIUM ASYMPTOTIC THERMAL NEUTRON SPECTRUM FOR CASE OF (1/v) ABSORPTION. R. Nordheim and D. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 8, 1960. Contract AT(04-3)-314. 20p.

An IBM-650 program is presented for computing Corngold's expression for the energy distribution of neutrons thermalized in an infinite homogeneous medium. The expression is valid for a medium consisting of an atomic moderator and uniformly distributed (1/v) poison. The Wolontis code was used for the program. A sample output sheet with graphite as moderator is included. (M.C.G.)

4442 (HMI-B14) PROGRAMM- UND ADRESSEN-ORGANISATION FÜR DIE SIEMENS-DATENVERARBEITUNGSANLAGE 2002 MIT EINER SPEICHERKAPAZITAT VON 2000 WÖRTERN IM KERNSPEICHER UND 10 000 IM TROMMELSPEICHER. (Program and Address Organization for the Seimens 2002 Data Processing Installation with a Memory Capacity of 2000 Words in the Core Memory and 10,000 in the Drum Memory). Werner Kuzenko (Hahn-Meitner-Institut für Kernforschung, Berlin). Feb. 1961. 109p.

Thesis submitted to Technische Universität, Berlin.

An "organization-form" and a compiler are described that greatly simplify the programming work on the Siemens Digital Computer 2002. The organization-form permits the development of a library program, whose structure the user does not need to know, if only approximate agreement is required over the range of parameters studied. An easily understandable symbolic method for addressing the programs and the words of the programs, along with the enlargement of the list of commands by means of psuedo-commands, make possible a simple and quite error-free method for generating programs. The compiler, which is based on the organization-form as a standard, serves to translate or decode the program-system. The compiler is equipped with a read-out program, which transfers material into machine-code form after it is read out. (T.F.H.)

4443 (NP-10989) TRANSFER FUNCTION ANALYZER, ANALOG COMPUTER MODEL, AND ANALOG COMPUTER TRANSFER FUNCTION SIMULATION STUDIES. Report No. 1478. (Bendix Corp. Research Labs. Div., Southfield, Mich.). June 1, 1960. For Power Reactor Development Co., Detroit. 184p.

TRANSFER FUNCTION MEASURING METHODS STUDY. Analytical studies, supported by analog computer simulation, of methods for measuring reactor transfer functions indicated that the different analyzers can be considered as groupings of similar pieces of electronic equipment. The methods analyzed include phase null, synchronous, and cross correlation. MODEL STUDY. An analytical study was made of the accuracy of phase and amplitude response of heat transfer with input frequency and the number of independent sections of the core as variables in comparison with an exact solution. Results indicate that 24 sections (eight axial core sections, eight axial radial-blanket sections, and two radial regions, each with four axial sections in the upper axial-blanket) would give sufficient accuracy for the frequency range and transfer functions considered. COMPUTER SIMULATION. Transfer functions were obtained for zero power, power per unit control reactivity, feedback reactivity per unit power, and power per unit inlet temperature. The transfer function results are presented graphically. An induced instability study was made which found that the reactor could be made unstable at a power level of 2.4 times the full power value of 300 Mw. (B.O.G.)

4444 (ORNL-3235) GETTING MULTICHANNEL ANALYZER DATA IN AND OUT OF THE IBM-7090 FOR PROCESSING. C. D. Goodman (Oak Ridge National Lab., Tenn.). Dec. 12, 1961. Contract W-7405-eng-26. 12p.

The present method used for handling multichannel-analyzer data at the ORNL 86-Inch Cyclotron is stated. FORTRAN subroutines for reading the analyzer data into the IBM-7090 computer and for printing out the processed data and punching processed data on cards are presented. (auth)

4445 (UCRL-6581) MONTE CARLO METHODS. A Bibliography covering the Period 1949 to June 1961. Rose Kraft and Carl J. Wensrich (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 11, 1961. Contract W-7405-eng-48. 50p.

A partially annotated bibliography is presented containing 508 references to Monte Carlo methods, covering the period from 1947 to June 1961. The references are arranged alphabetically by author. The sources consulted include: Abstracts of Classified Reports; Applied Science and Technology Index; Armed Services Technical Information Agency; Bibliographic Index; Bibliographie der Fremsprachigen Zeitschrifften Literatur; Mathematical Reviews; Nuclear Science Abstracts; and Operations Research, an Annotated Bibliography. (T.F.H.)

4446 BOUNDARY VALUES OF PARTIAL DERIVATIVES OF POISSON INTEGRAL. Marston Morse (Institute for Advanced Study, Princeton, N. J.). Anais acad. brasil. cienc., 33: 131-9(1961). (In English)

A simple proof is given for a theorem on the boundary values of the first partial derivatives of a function U^P, harmonic on the interior of an (n-1) sphere S, in the case where the boundary values of U^P on S depend in a special way on a parameter p on an arbitrary Hausdorff space Γ. (D.L.C.)

4447 NOTE ON THE CONSTRUCTION OF RATIONAL APPROXIMATIONS FOR THE ERROR FUNCTION AND FOR SIMILAR FUNCTIONS. W. W. Clendenin (Westinghouse Electric Corp., Pittsburgh). Communs. ACM (Assoc. Computing Machinery), 4: 354-5(Aug. 1961). (WAPD-T-1327)

The error function erf(y) is considered in the form $1 - \mathrm{erf}(y) = 2\pi^{-\frac{1}{2}} \int_y^\infty \exp(-\eta^2) d\eta$. A rational asymptotic approximation is used to find erf(y), with an accuracy to better than 1 part in 10^{10} for $y > 2.8$. The treatment is designed for computer use. (T.F.H.)

4448 SATURN. PART I. LARGE ANALOGUE COMPUTING INSTALLATION. T. O. Jeffries, C. B. Newport, H. A. Darker, and R. A. Flint (English Electric Co. Ltd., [Whetstone, Leics, Eng.]). Nuclear Power, 6: No. 68, 80-4(Dec. 1961).

A general purpose analog computer installation specifically designed for nuclear power station studies and known

as the Saturn is described. Saturn is divided into six computers each containing 252 amplifiers and an appropriate amount of non-linear equipment. The electronic units are in an air-conditioned room on the first floor above the control room. Six control panels containing 5120 point detachable patchboards, 600 10-turn coefficient potentiometers per computer, recorders, and multiplier and amplifier fault indicators are housed in the control room. Digital voltmeters are provided as well as automatic punch-out of amplifier voltages and digital initial conditions setting equipment. Reliability is ensured by paying considerable attention to routine preventive maintenance. Details of this are given together with fault statistics. Methods of checking the computer are described together with their possible extension. Typical problems are also described. (N.W.R.)

4449 IMPROVEMENTS IN OR RELATING TO COMPUTERS. Adrian Walton Fenton (to United Kingdom Atomic Energy Authority). British Patent 884,424. Dec. 13, 1961.

A simple arbitrary function computer is designed for deducing the size of an output quantity from the size of two input quantities. The computer comprises a surface impressed with graphs, each representing one value of the output for various values of the input quantities, means for causing a spot of light to traverse the graphs sequentially up to a point represented by the two input quantities, and means for counting the number of graphs traversed by the spot of light. A particular computer configuration is described for deducing the acidity of known solutions from density and electric conductivity measurements. (D.L.C.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstract 4472.

4450 (BMI-1546(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING SEPTEMBER 1961. Russell W. Dayton and Clyde R. Tipton, Jr. (Battelle Memorial Inst., Columbus, Ohio). Oct. 1, 1961. Contract W-7405-eng-92. 92p.

Progress is reported in the development and evaluation of reactor materials and components, fuel and fuel-element development studies, growth of UO_2 single crystals, radioisotope and radiation applications, corrosion studies of the fluoride-volatility process, assistance to the CANDU Reactor program, radiation effects studies of MGCR and SM-2 fuel materials, gas-cooled reactor program developments, corrosion of thorium and uranium under storage conditions, and gas-pressure bonding of beryllium-clad elements. (B.O.G.)

4451 (NAA-SR-6386) REMOVAL OF CARBON FROM LIQUID SODIUM SYSTEMS. W. J. Anderson (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-Gen-8. 25p.

Carburization of austenitic stainless steels has been observed to occur readily in carbon-bearing liquid sodium at 1000°F or higher. The high surface carbon content, 2 to 3%, caused by carburization in carbon-saturated sodium above 1000°F can produce a brittle case on the material. The carbon content of the carburized austenitic stainless steel depends on the degree of saturation of sodium with carbon. The effects produced by carburization revealed a need for control of carbon contamination in sodium systems. It was found that carbon could be removed effectively, either by calcium addition to sodium or by "gettering" through carburization of steel sheet in a carbon trap. The calcium addition was not considered to be immediately practical, because possible additional effects of the calcium in the system are unknown. The gettering method now is considered to be useful as a means of carbon removal. Carbon equilibrium data and diffusion data necessary for carbon trap design were determined for gettering with Type 304 and Type 410 stainless steels. The choice of gettering material and operating conditions will be dictated by the particular sodium system for which the trap is designed. Nomographs were constructed which relate variables pertinent to carbon traps utilizing Type 304 or Type 410 stainless steel. The variables included are: weight of carbon removed per unit weight of "getter", time, getter sheet thickness, carbon content of the sodium, and trap temperature. (auth)

4452 (NP-11144) A STUDY OF FUNDAMENTAL MECHANICAL PROPERTIES OF CERAMIC SINGLE CRYSTALS. Third Bi-Monthly Report, September 12–November 11, 1961. H. Dean Batha and Richard M. Drake (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Nov. 29, 1961. Contract NOw-61-0676-c. 11p.

The production of single crystals of relatively pure Si carbide, and of Si carbide crystals containing B in solid solution, is reported. Attempts to produce single crystals of Si carbide containing Al nitride in solid solution are discussed. Instruments for measuring the mechanical properties of the produced crystals are described. (T.F.H.)

4453 (DEG-Inf-Ser-87) THE PURIFICATION OF POTASSIUM AND SODIUM. C. Kunze. Translated by J. C. Ruckman (U.K.A.E.A. Development and Engineering Group, Risley, Lancs, Eng.) from Vakuum-Tech., 8: 168-70(1959). 8p.

Procedures and equipment are described for purifying potassium and sodium to spectrographic purity by vacuum distillation. The alkali metal must be pre-refined by passing over glass wool and spheres prior to distillation, and care must be taken to prevent impurity uptake from glass apparatus by the metal. (D.L.C.)

4454 (NP-tr-823(Pts. I & II)) [STEREOMETRIC METALLOGRAPHY]. S. A. Saltykov. A translation of "Stereometricheskaya Metallografiya" (A publication of the State Scientific-Technical Publishing House of Literature on Ferrous and Non-Ferrous Metallurgy, Moscow, 1958). 604p.

Second Revised and Supplemented Edition.

A basic treatment is presented on stereometric metallography, which is a combination of methods for the quantitative evaluation of spatial microscopic structure of metals and alloys. The properties of metals and alloys and their behavior in hot and cold working are shown to be related directly to parameters of stereometric structure. (D.L.C.)

4455 MECHANICAL ADHERENCE OF FLAME-SPRAYED COATINGS. Tibor S. Laszlo (Avco Corp., Wilmington, Mass.). Am. Ceram. Soc. Bull., 40: 751-5 (Dec. 1961).

Theories on the adherence mechanism of coatings to metals fail to explain observed differences in adherence to differently prepared but apparently similar substrate surfaces. It is found that interface contour roughness alone does not determine the strength of adherence. It is proposed that the crystal structure and shape of the metal protuberances are the factors that differ at surfaces prepared by different methods. Protuberances consisting of single crystals form much stronger anchors for coatings than polycrystalline protuberances. Anisotropy in the rate of chemical and electrolytic reactions makes it possible to prepare metal surfaces with the more favorable structure by preferred selective etching. Principles for the selection of etching compositions and etching conditions are discussed. Particular processes developed for several metals are presented. (auth)

4456 GRAPHITE TECHNOLOGY. John M. Neff (Illinois Inst. of Tech. Armour Research Foundation, Chicago). Frontier, 23: No. 2, 28-31(1961).

The advantages, disadvantages, properties, and preparation of graphite are discussed. A custom built, carbon resistor furnace used for determining the engineering properties of ARF prepared carbon specimens is described, and the results of the study are given. (P.C.H.)

4457 INVESTIGATIONS ON THE OXIDATION OF COPPER BERYLLIUM ALLOYS AT HIGH TEMPERATURE. Fritz Maak (Max-Planck-Institut für Physikalische Chemie, Gottingen, Ger.). Z. Metallk., 52: 538-45(Aug. 1961). (In German)

The various possibilities of oxide layer structure, obtained during the oxidation of a binary alloy A-B with the oxides AO and BO, are surveyed and compared with experimental results on the oxidation of Cu–Be alloys at 850°C. Alloys with 0.77, 1.5, 2.7, and 6.6 at.% Be scale almost as fast as pure copper by forming multiphase oxide

layers whereas an alloy with 12.6 at.% Be scales more slowly by lone build-up of a closed BeO layer. In the first case the following layer sequence has been found: initial alloy Cu–Be | Cu + BeO | Cu_2O + BeO + pores | Cu_2O | O_2. The results of different investigation methods lead to the following conclusion: In Cu_2O, copper ions and electrons migrate towards the outside surface. In the three-phase layer Cu_2O + BeO + pores, oxygen migrates, as O_2 molecules, within the pores inward. Moreover, oxygen atoms are dissolved in the metal and diffuse inward in order to form BeO according to the known mechanism of internal oxidation. (auth)

4458 PLUTONIUM 1960. The Proceedings of the Second International Conference on Plutonium Metallurgy, Grenoble, France, 19-22 April, 1960. Emmanuel Grison, William B. H. Lord, and Robert D. Fowler, eds. London, Cleaver-Hume Press Ltd., 1961. 817p. £9 9s.

Forty-two papers, which were presented at the conference, are given. Abstracts were prepared for 31 papers, and the remaining 11 papers on physical properties of plutonium and its alloys, phase diagrams of plutonium alloy systems, the constitution, kinetics, and decomposition of ternary alloys of U–Pu–Mo, plutonium oxides, mechanical properties and formability of unalloyed plutonium at Hanford, and properties of some plutonium fuels were previously abstracted. Subject and author indexes are included. (P.C.H.)

4459 KINETICS OF THE β-α TRANSFORMATION IN PLUTONIUM. R. G. Loasby and J. N. Lowe (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.3-16 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Isothermal transformation data covering the temperature range –100 to 80°C is presented for the β-α phase change in pure plutonium. Electrical resistance and dilatometric methods were used to obtain information on the kinetics of the change and to investigate the mechanism of void formation. The T-T-T curve shows, at –20°C, a minimum incubation period of about 10 sec, and at –45°C, a maximum rate of transformation of 1200 %/min. Above 30°C the transformation is incomplete; the amount of retained β-phase increases with the temperature of transformation, values of up to 40% β-phase being obtained at 60°C. (auth)

4460 STUDY BY DILATOMETRY OF THE $\delta \rightarrow \gamma$ TRANSFORMATION OF PURE PLUTONIUM. R. Pascard (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). p.16-25 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

Numerous dilatometric cycles, as well as the observation of the isothermal behavior of plutonium samples, permit a detailed study of $\delta \rightarrow \gamma$ transformation. It is concluded that in spite of its different aspects, the transformation is a martensitic one for all the temperature intervals studied (from 310 to 170°C). It is shown furthermore, that this interpretation is justified by the close analogy between the two structures δ and γ. (auth)

4461 THE ELASTIC CONSTANTS OF PLUTONIUM. A. E. Kay and P. F. T. Linford (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.51-8 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

An ultrasonic resonance method was used to investigate the elastic properties of plutonium at room and elevated temperatures. Longitudinal, flexural, and torsional resonances, excited and detected by magnetostrictive transducers, gave values for Young's modulus, Poisson's ratio, the rigidity modulus, and the degree of anisotropy. Experiments were made on as-cast metal of density 19.5 g/cm^3 and metal of density 19.7 g/cm^3 prepared by cooling under pressure. The results of measurements extending up to a temperature of 540°C are reported. (auth)

4462 PRINCIPLES OF THE ALLOYING BEHAVIOUR. PART II. QUASI-THERMODYNAMIC APPROACHES. J. T. Waber and K. A. Gschneidner, Jr. (Los Alamos Scientific Lab., N. Mex.). p.109-34 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The influences of alloying elements on the relative stabilities of liquid plutonium with respect to ϵ-Pu are discussed from several viewpoints based on thermodynamics. The proposals of Betterton and Frye, Jones, Oelsen and Wever, and Raynor are applied to plutonium alloys. The general findings are discussed in terms of the effects of electron transfer and electron number of the solute atom. (auth)

4463 PHYSICAL FACTORS INFLUENCING THE STABILITIES OF PLUTONIUM PHASES. PART I. DELTA PLUTONIUM. K. A. Gschneidner, Jr., R. O. Elliott, and V. O. Struebing (Los Alamos Scientific Lab., N. Mex.). p.134-42 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Some physical factors which influence the ability of certain plutonium alloys to retain δ-phase at room temperature are discussed. It is shown experimentally that, in general, for an alloying element to be a δ-retainer it must have a specified valency and a favorable size factor. Known exceptions to these two conditions are discussed and an explanation of the anomalous behavior is proposed. For a given group of isovalent elements the minimum amount of a δ-retainer necessary to stabilize the δ-phase at room temperature appears to be dependent on the size of the alloying element. (auth)

4464 THERMAL EXPANSION OF SOME DELTA PLUTONIUM SOLID SOLUTION ALLOYS. R. O. Elliott, K. A. Gschneidner, Jr., and C. P. Kempter (Los Alamos Scientific Lab., N. Mex.). p.142-55 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

A series of experiments was carried out using the x-ray and dilatometric methods, in order to determine the thermal expansion of binary plutonium-rich, single-phase δ alloys containing zinc, aluminum, cerium and zirconium. These experiments were made over temperature ranges as large as the phase transformations in the various systems allowed. The discussion of the results is governed by the terms of the classic theory of alloys. (auth)

4465 THE PREPARATION OF HIGH PURITY PLUTONIUM. B. Blumenthal and M. B. Brodsky (Argonne National Lab., Ill.). p.171-86 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

High-purity plutonium was prepared from impure plutonium anodes by fused salt electrolysis. The final product, containing 65 ppm of impurities by weight, is obtained from metal containing over 1500 ppm, with an overall efficiency of over 60%. The major remaining impurities included carbon, uranium, and silicon. Effects of process variables on the purity of the product are presented. The use of liquation for the further purification of the product is discussed. These results are discussed in comparison to high purity plutonium prepared by other techniques with particular emphasis on the reliability of the quoted purities, and on the ultimate possibilities of the methods. (auth)

4466 REALIZATION OF THE PRODUCTION CHAIN OF PLUTONIUM ON AN INDUSTRIAL SCALE AT THE MARCOULE CENTER. J. Kerjean (Commissariat a l'Energie Atomique, Paris). p.186-92 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

The process of reduction by calcium is discussed and then the care which must be taken as a result of the emission of fast neutrons by the (α, n) reaction in plutonium tetrafluoride is stressed. The principles which were followed in the realization are enumerated, then the sequence of the manufacturing operations is described including a brief description of the glove-boxes. Finally, the last part deals with the main difficulties which were encountered, namely: gas tightness of the glove-boxes, fluorite crucible breakage, and regulation of the argon purification. Some data are also mentioned. The most important one, the yield, averages over 97%. (auth)

4467 MODES OF PURIFICATION IN THE CONVERSION OF PLUTONIUM NITRATE TO METALLIC SHAPES. B. Weidenbaum (General Electric Co., Pleasanton, Calif.). p.192-202 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Consideration is given to the methods by which plutonium is purified at each chemical process-step in converting plutonium nitrate to metal, and the subsequent melting and casting of the metal into an appropriate shape for shop operations. The degree of purification that may be obtained in each chemical process-step is discussed in a qualitative way on the basis of laboratory investigations or plant operating experience. In the metallurgical phase of the process, melting of the metal and casting to shape, the removal of impurities by the oxide dross technique and by volatilization is considered. The amount of purification that may be achieved by the oxide dross technique is discussed on the basis of operating experience with plutonium, and with uranium. Calculations are made to determine which impurities can be removed from molten plutonium by volatilization. For this purpose, the Langmuir equation for the rate of evaporation from a surface into a vacuum is utilized on the basis that it applies to ideal solutions as well as pure metals. (auth)

4468 CALCIUM REDUCTION OF PLUTONIUM HALIDES TO METAL. W. J. Maraman and R. D. Baker (Los Alamos Scientific Lab., N. Mex.). p.202-15 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Plutonium metal is prepared by calcium reduction of a halide of plutonium. The development of this process during the period 1943 to 1946 is reported. Methods and equipment used to prepare metal of greater than 99 wt % purity in good yield from either plutonium(III) chloride or plutonium(IV) fluoride are presented. The effects of process variables such as reduction scale (varied from 1 to 500 g Pu), the use of iodine as a booster, reduction temperature-time cycle, purity of halide, and crucible properties on the product yield and purity are also discussed. (auth)

4469 THE ATMOSPHERIC OXIDATION OF PLUTONIUM METAL. J. F. Sackman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.222-9 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Initial results are presented on the atmospheric oxidation of α-plutonium and δ-stabilized (3.5 at. % aluminum) alloy over a range of temperatures and humidities. Below 100°C, with the exception of the reaction with dried air, oxidation is essentially interfacially controlled leading to slopes ≥ 1 on the log weight increase versus log time plots. However, at 30°C and 95% relative humidity, α-plutonium exhibits accelerated, parabolic, logarithmic, and linear corrosion with increasing time—a change on appearance being observed at each change of mechanism. At 100°C and 0% relative humidity, cracking of the oxide film gives a series of parabolic type curves on the plot of weight increase against time. Initial oxidation gives a black oxide which is replaced on the surface by the yellow dioxide. Completely oxidized specimens show a gain in weight greater than that corresponding to PuO_2. The δ-stabilized alloy has enhanced corrosion resistance. The merit ratios (weight increases for α-plutonium/weight increases for alloy in the same times) are as high as 130 when corrosion is rapid. Specimens of α-plutonium (1 cm × 1 mm discs) normally disintegrate after about 12% of the total gain in weight, whereas δ-stabilized specimens are still intact after over 88% of the total gain, thus indicating intergranular or transgranular corrosion of α-plutonium. (auth)

4470 PLUTONIUM METALLOGRAPHY. A. E. Kay, J. N. Lowe, and B. R. Spicer (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.229-36 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

An account of a metallographic technique for plutonium metal and its alloys covering the topics of heat-treatment, specimen mounting, and preparation, polishing, ion-bombardment etching, and optical examination is given. (auth)

4471 A PLUTONIUM MONITOR. D. Aliaga-Kelly and D. Taylor (Plessy Nucleonics Ltd., Northampton, Eng.). p.237-45 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

A completely transistorized unit was developed which can detect the 17 kev x rays emitted with 4% of the alphas from Pu^{239}; 0.02 μc was detected through 1 cm of raw beefsteak (to simulate human tissue) with a signal-to-noise ratio of 40 to 1. The probe contains a thin NaI(Tl) phosphor optically coupled to a specially-selected high-gain, low-noise photomultiplier. The monitor box contains a pulse amplifier, single-channel pulse-height analyser, regulated e.h.t. supply, ratemeter, and register, all in a space of 24 cm × 17 cm × 15 cm, and weighing 5.5 kg. A smaller unit with internal batteries weighs 2 kg and is contained in a space of 19 cm × 11 cm × 10 cm, omitting only the electromagnetic register. (auth)

4472 SAFETY CONSIDERATIONS IN PLUTONIUM METALLURGY TECHNOLOGY. Ellis L. Stout (Los Alamos Scientific Lab., N. Mex.). p.245-56 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Safety engineering aspects of the Los Alamos plutonium facilities are discussed. The hazardous properties of plutonium require special techniques of accident loss control and, therefore, a high cost of specialized equipment must be rigorously maintained. The discussion is particularly concerned with nuclear safety. Fire protection and extinguishment methods for plutonium laboratories are of concern, also. Measures discussed include inert gas systems, smothering with various dry powders, quenching with high flash point oils, and controlled burning. Procedures for handling emergency conditions and alarm systems are also given. (P.C.H.)

4473 THE PLUTONIUM–RUTHENIUM AND PLUTONIUM–NEPTUNIUM BINARY PHASE DIAGRAMS. R. G. Cope (Mond Nickel Co., London), D. G. Hughes, R. G. Loasby, and D. C. Miller. p.280-9 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The plutonium-rich ends of the diagrams as far as 75 at. % plutonium were studied using dilatometry and thermal analysis. The main features of interest are as follows. In the plutonium–ruthenium equilibrium diagram: the eutectic composition is determined as 12 at. % ruthenium; there is a range of composition, from 3–6 at. % ruthenium, for the ζ-compound; and there is a maximum solubility of ruthenium in ϵ-phase plutonium of 4.5 at. % at 530°C. In plutonium–neptunium alloys: there is a continuous solubility of neptunium in α-phase plutonium which is accompanied by a progressive raising of the α-β transition temperature with increasing neptunium content; and there is complete solubility between γ-phase neptunium and ϵ-phase plutonium. (auth)

4474 THE PLUTONIUM–COPPER PHASE DIAGRAM. T. B. Rhinehammer, D. E. Etter, and L. V. Jones (Mound Labs., Miamisburg, Ohio). p.289-300 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The constitution of the plutonium–copper binary alloy as determined by differential thermal analysis is presented. The system is characterized by two congruent melting compounds, $PuCu_2$ (m.p. 865°C) and Pu_4Cu_{17} (m.p. 954°C); two incongruent melting compounds, $PuCu_4$ (m.p. 906°C) and Pu_2Cu_{11} (m.p. 926°C); three eutectics, 6 at. % copper (m.p. 626°C), 70.5 at. % copper (m.p. 849°C), and 91 at. % copper (m.p. 881°C); and two peritectics at 75 at. % (m.p. 906°C) and 85.5 at. % (m.p. 926°C). Solid solution was found above 97 at. % Pu. The apparatus, the method of investigation, and the binary alloy phase diagram are discussed. (auth)

4475 THE PLUTONIUM–CARBON SYSTEM. R. N. R. Mulford, F. H. Ellinger, G. S. Hendrix, and E. D. Albrecht (Los Alamos Scientific Lab., N. Mex.). p.301-11 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

A phase diagram for the plutonium–carbon system was constructed from x-ray, metallographic, and thermal evidence. At least four carbide phases are shown to exist. In addition to the compounds PuC and Pu_2C_3 which were previously reported, a phase, designated ζ, containing slightly less carbon than PuC was found. The ζ-phase decomposes to PuC and ϵ-Pu upon heating at 575°C. A higher carbide, probably PuC_2, was found. This higher carbide appears to be unstable with respect to Pu_2C_3 and carbon at temperatures below about 1750°C. PuC and Pu_2C_3 melt peritectically at 1654° and 2050°C, respectively. PuC appears to exist as a phase deficient in carbon and not as the stoichiometric compound. Pu_2C_3 exists as the stoichiometric compound. The eutectic composition between Pu and PuC is very close to pure plutonium; so close that a eutectic structure was not observed in photomicrographs. Thermal data show the eutectic temperature to be about 630°C, whereas pure plutonium melts at 639°C. The presence of carbon does not affect the solid transition temperatures of plutonium, suggesting that the solubility of carbon in solid plutonium is very small. (auth)

4476 THE THERMAL EXPANSION OF PuO_2 AND SOME OTHER ACTINIDE OXIDES BETWEEN ROOM TEMPERATURE AND 1000°C. N. H. Brett and L. E. Russell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.397-410 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The thermal expansion behavior of plutonium, uranium, and thorium dioxides, of a 1 mole % PuO_2–99 mole % UO_2 solid solution, and of $PuO_{1.77}$ was studied between room temperature and 1000°C in an argon atmosphere. For purposes of comparison, the expansion of beryllium, stainless steel, and sapphire was determined under the same conditions. (auth)

4477 THE VOLATILITY OF PLUTONIUM OXIDE. R. N. R. Mulford and L. E. Lamar (Los Alamos Scientific Lab., N. Mex.). p.411-21 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The volatility of PuO_2 was measured by the Knudsen effusion technique. It was shown that PuO_2 is the congruently vaporizing solid in the system. Assuming that PuO_2 molecules are the predominant gaseous species over solid PuO_2, the vapor pressure is given by $\log p\ (atm) = -29240/T + 8.072$ in the range 2000 to 2400°K. The dissociation energy of PuO_2 is estimated to be 13.5 ev at 0°K. (auth)

4478 THE PRODUCTION OF PuO_2–UO_2 IRRADIATION PELLETS. N. H. Brett, J. D. L. Harrison, and L. E. Russell (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.430-48 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The development of a process for preparing dense uniform pellets of PuO_2–UO_2 is described. Details of equipment construction, the effects of various parameters on sintered density, and some properties of the final pellets are included. (auth)

4479 SINTERING OF URANIUM AND PLUTONIUM OXIDES. Alain Bel (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). p.449-55 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

Experiments were made in order to study the influence of sintering on plutonium oxides and mixed plutonium and uranium oxides, of the method of preparation (coprecipitation or physical mixing, starting material), of the sintering temperature, and of the specific surface area of the oxide. The behavior of these oxides is shown to be similar to that of pure uranium oxide and the use of large specific surface area powders for preparing oxide mixtures is emphasized when good homogeneity of the sintered products is required. (auth)

4480 ROLLING AND MECHANICAL TESTING OF PLUTONIUM. C. T. Horton and B. J. Ward (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). p.499-512 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Experiments on the rolling of pure plutonium are described, and the problem of distortion of the sheet during cooling is discussed. Mechanical properties of the rolled sheet are given over a range of temperature. The data are tabulated. (auth)

4481 PLUTONIUM DISCS FOR LAMPRE CRITICAL ASSEMBLY. W. D. McNeese and J. W. Anderson (Los Alamos Scientific Lab., N. Mex.). p.570-9 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Twenty-five disks of δ-stabilized plutonium and close dimensional tolerances were required for criticality measurements for the Los Alamos Molten Plutonium Reactor Experiment (LAMPRE). These disks were 0.125 in. thick and 5.937 in. diameter. They were to be handled and tested in equipment and laboratories used for other than plutonium work; therefore, it was necessary that they be in tight α-containing cans. Two methods were used for making these disks: blanking from sheet stock made by extrusion and casting, and direct machining. In the blanking method, a cast-feed ring was rough machined to weight and then extruded into a tube of the proper wall thickness

in a specially designed direct extrusion die assembly. This tube was split and flattened. Disks were cut from the roughly flattened sheet with a blanking die in a slow moving hydraulic press. The disks were then flattened and pressed to exact size in a coining die. In the machining method, an oversize disk was cast in an alumina-coated graphite crucible in a vacuum furnace. This casting was machined to dimensions in a lathe. The disks were canned in 0.005 in. thick nickel cans which were formed by blanking and drawing. The disks were carefully assembled in the cans and the edges sealed with a lead-tin solder. (auth)

4482 COMPARISON OF DIFFERENT FUELS DESTINED FOR THE FAST REACTOR RAPSODIE. P. Bussy (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France) and P. Zaleski. p.589-98 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

Since the Rapsodie reactor may be used with plutonium-based fuels, the physical, chemical, and nuclear properties of materials are compared for the three following fuels: U–Pu–Mo alloy, U–Pu mixed oxides, and U–Pu mixed carbides. (auth)

4483 PLUTONIUM FUEL SYSTEMS FOR THE NEXT LARGE FAST BREEDER POWER REACTORS. R. E. L. Stanford and R. J. Hennig (Detroit Edison Co., Detroit). p.598-617 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Plutonium fuel materials which appear to be most promising for early application in large fast breeder reactor power plants are discussed. The discussion is limited, however, to only large reactors with core volumes in the range of 800 to 3000 liters. General observations pertinent to fast reactor fuel systems and a preliminary evaluation of large fast breeder reactor power plants made by the Detroit Edison Company are given. Certain conclusions which have a bearing on the development of plutonium fuel element technology are listed. (P.C.H.)

4484 TESTING COMPATIBILITY IN THE USE OF STAINLESS AND U–Pu–Mo ALLOYS. M. Mouchnino (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). p.649-71 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

The formation of a liquid phase at the interface of two samples, one of stainless steel and the other of U–Pu–Mo alloy, was studied. The two surfaces in contact are prepared by mechanical polishing and thorough cleaning. Heating under vacuum (2×10^{-5} mm Hg) is obtained by Joule effect. The explored range of temperature extends from 450 to 900°C and each isothermal run does not exceed 30 min. In all cases the liquid phase revealed by micrography appears at about 450°C. The rate of formation increases with molybdenum content in U–Pu–Mo alloys. This low temperature precludes the use of stainless steel as canning material in the breeder 'Rapsodie'. (auth)

4485 THE VISCOSITY OF A LIQUID PLUTONIUM–IRON EUTECTIC ALLOY. L. J. Wittenberg, L. V. Jones, and D. Ofte (Mound Labs., Miamisburg, Ohio). p.671-83 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

The viscosity of a liquid plutonium–iron eutectic alloy, which contains 9.5 at. % iron and melts at 411°C was determined up to 808°C by an oscillating cup viscosimeter. This type of apparatus employed a right-circular cylindrical cup containing the liquid under investigation attached to a torsion fiber. The dampening effect of the liquid upon the normal oscillations of the pendulum was a function of the viscosity of the liquid. The amplitudes of the oscillations of the pendulum were measured by a photographic technique. The periods of the oscillations were determined by an automatic timing mechanism. The reliability of the viscosimeter was demonstrated by following the expected function of the viscosity of liquid lead and bismuth over a larger temperature range than was previously reported. It was necessary to employ two different periods for the pendulum before the viscosity of the plutonium alloy could be calculated over the reported temperature range. The viscosity of the alloy increased as expected with decreasing temperatures, from 6.14 cP at 808°C to 22.4 cP at 433°C, and the activation energy for viscous flow was determined to be 5237 cal/mole. Both the viscosity values and the activation energy are large values for liquid metal systems. (auth)

4486 CUBIC EXPANSION OF PLUTONIUM AND PLUTONIUM–IRON EUTECTIC BETWEEN ROOM TEMPERATURE AND 700 TO 800°C. Ford W. Knight (Los Alamos Scientific Lab., N. Mex.). p.684-704 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Density and cubic expansion data for plutonium–iron eutectic were required for purposes of design and control of liquid plutonium fuelled reactors. Determinations were made on plutonium and its iron eutectic using a liquid metal displacement technique. Feasibility of the technique was established by making determinations on materials with known densities and expansion coefficients. New data determined for plutonium included its volume change upon melting and its coefficient of expansion in the liquid range. Data determined for plutonium–iron eutectic included intraphase expansion coefficients and interphase volume changes in the solid range, the volume change upon melting, and the expansion coefficient in the liquid range. (auth)

4487 AN INITIAL ASSESSMENT OF ALUMINUM–PLUTONIUM ALLOYS FOR WATER-COOLED POWER REACTORS. T. I. Jones (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.720-44 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In English)

Metallographic examinations, density, and hardness measurements were carried out on cast and annealed aluminum alloys containing 5 to 20 wt % plutonium. Interactions between Zircaloy-2 and Al–Pu alloys were studied. Core liquation caused rapid sheath dissolution, ~0.06 cm/h (~0.025 in./h) at 660°C, but sheath/core reaction would be insignificant at 300 to 400°C, which is the range appropriate to water-cooled power reactors. Short-term, static corrosion tests were carried out in deionized water at 340°C. Corrosive attack on bare alloys varied from ~0.008 cm/h (~0.003 in./h) for the 5 wt % alloy to 1.5×10^{-5} cm/h (6×10^{-6} in./h) for the 20 wt % alloy. Alloys sheathed in defected Zircaloy-2 cans underwent less attack; the 5 wt % alloy corroded 0.005 cm (0.002 in.), and anodically treated 5 and 10 wt % alloys showed no trace of attack after 20 hr. Alloys sheathed in Zircaloy-2 were irradiated successfully for four months under power reactor conditions. Irradiation at ~400°C increased the hardness and reduced the density of the core alloys by ~2% when the fraction of total atoms fissioned was 0.002. Annealing in excess of 580°C caused further volume increases. (auth)

4488 FABRICATION OF ROLLED ALUMINUM–PLUTONIUM ELEMENTS. Francois Stosskopf (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). p.744-63 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (In French)

Fuel elements containing plutonium were made for ir-

radiation tests in the Saclay EL3 reactor. The active part of these fuel elements is a rolled plate with aluminum picture frame and cover and 10% Pu–Al alloy core. The core is roll-bonded to the can. Casting and machining of the core is carried out in glove boxes containing air or argon. After finishing to dimensions, the core is cleaned by an ultrasonic method which allows assembling and welding to take place in free air. The sandwich, freed from gas, is then rolled hot and cold, radiographed for core location, and sheared. Finally, the sheared plate is rolled into the form of a cylinder and fixed on an aluminum support which positions it in the channel of the reactor. Tests are actually in progress to improve, by interposition of 13% Si–Al alloy, the welding between the edge of the core and the picture frame in a direction parallel to the rolling. (auth)

4489 SUMMARY OF ALUMINUM–PLUTONIUM FUEL DEVELOPMENT AT HANFORD. I. D. Thomas and O. J. Wick (General Electric Co., Richland, Wash.). p.764-78 of "Plutonium 1960." London, Cleaver-Hume Press Ltd., 1961. (HW-SA-1775). (In English)

The advantages and disadvantages of Al–Pu as a reactor fuel material are summarized. The more important advantages include: low fabrication cost, good irradiation stability, high thermal conductivity, excellent plutonium contamination control, reasonable hot-water corrosion resistance (350°C) when alloyed with small amounts of nickel and silicon, and amenability to simplified, close-coupled recycling processes. Disadvantages include: low melting temperature, a high thermal expansion which causes problems when the fuel is coupled with zirconium cladding, and application largely as a spike element. Physical and mechanical property data are summarized including: tensile properties of both as-cast and extruded material, thermal expansion data, diffusion constant for Al–Pu aluminium couples, preliminary thermal conductivity data, corrosion properties of various Al–Pu alloys, and irradiation data. Developments on a wide variety of fabrication techniques are detailed. Descriptive data are presented on large scale cryolite process reduction of PuO_2 with aluminium, casting, extrusion, co-extrusion cladding, injection casting, drawing, rolling, roll cladding, Zircaloy cladding, and welding. A description of the fabrication of Al–Pu elements for the Materials Test Reactor (MTR), the Plutonium Recycle Reactor (PRTR), and irradiation testing are summarized. (auth)

Corrosion

Refer also to abstract 4618.

4490 (AECL-1265(Paper 5)) FORMATION AND RELEASE OF CORROSION PRODUCTS BY CARBON STEEL IN WATER AT pH^{10}, 150° AND 205°C. H. K. Rae and E. Yatabe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Paper 5 of PROCEEDINGS OF THE TRIPARTITE CONFERENCE ON TRANSPORT OF MATERIALS IN PRESSURIZED-WATER NUCLEAR SYSTEMS, CHALK RIVER, FEBRUARY 28 AND MARCH 1, 1961. p.63-92. (CEI-126)

Out-of-reactor loop experiments were conducted to determine the release of corrosion products from carbon steel exposed to pH10 water at 150 and 205°C. Emphasis was placed on the release during the first few hundred hours of exposure of new surfaces. The effects of oxygen in the water and of rust initially on the surfaces were determined. The corrosion rate of 150 and 205°C was found to be close to that at 260 to 315°C. The rate of release of the corrosion product to the water was very low and an adherent magnetite film was formed. The concentration of crud in the water was always less than 1 ppm, and after initial exposure of the steel the crud level quickly declined to less than 0.1 ppm. The presence of oxygen increased crud release rates. The experiments indicated that a carbon steel system could be conditioned to provide an adherent magnetite corrosion product film, clean water conditions, a low corrosion rate, and a very low crud release rate, by operation for several weeks at 150°C with pH10 water free of oxygen. (auth)

4491 (AECL-1265(Paper 9)) SURFACE FILM FORMATION IN REACTOR SYSTEMS. W. E. Parkins (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Paper 9 of PROCEEDINGS OF THE TRIPARTITE CONFERENCE ON TRANSPORT OF MATERIALS IN PRESSURIZED-WATER NUCLEAR SYSTEMS, CHALK RIVER, FEBRUARY 28 AND MARCH 1, 1961. p.115-89. (NAA-SR-6048)

Film formation in water and organic cooled reactor systems is analyzed, from the standpoint of the detailed mechanisms involved. The results indicate that a single basic process, which is dependent upon the presence of suspended solids in the coolant, is responsible for the production of the surface films. The process involves transport of these particles to the surface, and attachment there through the establishment of chemical bonds. Brownian motion appears to be the principal mechanism that brings the particles in contact with the surface. Within a reactor core, two mechanisms that are not present in conventional situations can have an overriding effect on the probability of permanent attachment. These are the nuclear radiation field and the electric current of beta electrons injected into the coolant from the fuel elements. Semiquantitative expressions for these mechanisms are developed that verify observations on film formation rates. (auth)

4492 (HW-69681) RECOVERY AND RECRYSTALLIZATION OF ZIRCONIUM AND ITS ALLOYS. PART 4. CORROSION BEHAVIOR. S. H. Bush, R. S. Kemper, and D. L. Gray (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1961. Contract AT(45-1)-1350. 30p.

Representative specimens of zirconium, Zircaloy-2, vacuum-melted Zircaloy-3, and argon-melted Zircaloy-3 were corrosion tested in the as-cold-worked state and after various heat treatments; all testing was done in static autoclaves in water at 360°C. Weight gains were measured at regular intervals for periods as long as 364 days. Testing was discontinued in specimens when the weight gain exceeded 100 milligrams per square decimeter, or when excessive spalling occurred. No attempt was made to establish per cent of theoretical hydrogen picked up. Little or no difference in corrosion behavior was observed in the various materials when in similar conditions of cold work or heat treatment. Vacuum annealing tended to result in lower corrosion rates than air or helium. All materials had poorer corrosion resistance in the cold-worked condition than after recovery or recrystallization anneals. (auth)

4493 (NP-10978) COMPORTEMENT A L'OXYDATION A L'AIR ET A CO_2 DE GRAPHITES ARTIFICIELS. (Oxidation Behavior in Air and CO_2 of Artificial Graphite). S. Keraudy and J. Perin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Jan. 13, 1961. 10p. (DPC/PCA/61-14)

The investigation proved that it is difficult to forecast systematically the order of magnitude of the rate of oxidation in air and in CO_2. While it seems that samples placed

in the upper part of a furnace should have a tendency to have a weaker rate of oxidation in air, not one valuable verification was made for CO_2. Highly purified graphite has only a very slight rate of oxidation in air and in CO_2. Some specimens with larger sodium content generally oxidized more rapidly than samples with smaller content. It was confirmed that, in nuclear graphite, the presence of certain impurities and especially their distribution influences oxidation more in air than in CO_2. (P.C.H.)

4494 (NP-11056) CORROSION AND HIGH TEMPERATURE OXIDATION OF METALS, SYMPOSIUM, MAY 3, 1960. (Sentralinstitutt for Industriell Forskning, Blindern, Norway). Aug. 1960. 62p. (SI-Pub.-290). (In English and Norwegian)

Four papers are included. Separate abstracts have been prepared for each. One paper is in English and three in Norwegian. (P.C.H.)

4495 (NP-11056(p.3-15)) THE THERMOCHEMISTRY AND KINETICS OF OXIDATION OF GROUPS IVA AND VA TRANSITION METALS. O. Kubaschewski (Gt. Brit. National Physical Lab., Teddington, Middx., England).

The thermochemical properties of Zr, Hf, Ta, Ti, V, and Nb oxides and the kinetics of their formation are discussed. Exceptional phase relations are considered. Various works are cited in discussing the oxidation-time relations, which are logarithmic, cubic, and parabolic linear. Some empirical experimental evidence on the effects of alloying elements on the oxidation resistance of the metals is also discussed. (P.C.H.)

4496 (NP-11056(p.16-31)) HØYTEMPERATUR OKSYDASJON AV NIOB. (High Temperature Oxidation of Niobium). Per Kofstad (Sentralinstitutt for Industriell Forskning, Blindern, Norway).

The reaction of oxygen with niobium was examined at 300 to 1200°C and oxygen pressures of 0.1 mm Hg to 1 atm. The oxidation experiments were studied using the structural method. The structures of reaction products were determined by x-ray and electron diffraction techniques. The effects of oxygen chemisorption, diffusion, and phase boundary reactions were determined. The structures of the various oxides formed are described. (M.C.G.)

4497 (NP-11056(p.32-40)) STRUKTURELLE OG MEKANISKE EGENSKAPER HOS WHISKERS. (Structural and Mechanical Properties in Whiskers). Joar Markali (Sentralinstitutt for Industriell Forskning, Blindern, Norway).

The mechanical properties and structure of whiskers formed in metals and ceramic materials are discussed. Studies made on whiskers in iron and copper are described. The effects of geometric magnitudes on the whisker strength were evaluated. (M.C.G.)

4498 (NP-11056(p.41-62)) KORROSJON OG ELEKTRODEKINETIKK. (Corrosion and Electrode Kinetics). Tor Hurlen (Sentralinstitutt for Industriell Forskning, Blindern, Norway).

The conditions of energy and kinetics for metal corrosion by aqueous solutions were investigated. The corrosion reaction was studied as anodic and cathodic reactions of oxidation and reduction. Corrosion rates and the conditions determining them were investigated. (M.C.G.)

4499 (ORNL-3230) EFFECT OF HEAT FLUX ON THE CORROSION OF ALUMINUM BY WATER. PART III. FINAL REPORT ON TESTS RELATIVE TO THE HIGH-FLUX ISOTOPE REACTOR. J. C. Griess, H. C. Savage, J. G. Rainwater, T. H. Mauney, and J. L. English (Oak Ridge National Lab., Tenn.). Dec. 20, 1961. Contract W-7405-eng-26. 55p.

The effect of very high heat fluxes on the corrosion of 1100 and 6061 aluminum alloys by water was investigated. The test conditions generally simulated those expected to exist during operation of the High-Flux Isotope Reactor. At heat fluxes between 1 and 2×10^6 Btu/hr-ft^2 and with coolant temperatures and velocities in the ranges of 131 to 250°F and 31 to 51 fps, respectively, a layer of boehmite ($\alpha\, Al_2O_3 \cdot H_2O$), which has low thermal conductivity, formed on the water-cooled aluminum surfaces during test. When only relatively thin films formed, the boehmite adhered tightly to the aluminum, but in those cases where relatively thick films formed, some boehmite spontaneously spalled from the surface. The rate at which the boehmite formed on the surface (and consequently the rate at which the aluminum temperature increased) was a function of the temperature at the specimen-water interface and the pH of the coolant. The lower the temperature and the lower the pH (in the range of 5.0 to 6.5 with HNO_3), the lower the rate of corrosion-product formation. Within the ranges investigated, pressure and flow rate were without effect, and the same results were obtained with 6061 and 1100 aluminum. In those cases where the pH of the coolant was adjusted to 5, corrosion penetration was uniform and even under the most severe conditions did not exceed 1.5 mils in 10 days. When the test conditions were such that the rate of oxide formation was high and oxide spalled from the surface of the specimen, localized attack of the aluminum in the form of subsurface voids extending several mils into the metal was always observed. From the experimental data, fluid-film heat-transfer coefficients were calculated and the thermal conductivity of the corrosion product was estimated. The fluid-film heat-transfer coefficients were in excellent agreement with those determined by others under similar conditions, and a value of 1.3 ± 0.2 Btu/hr-ft^2-°F/ft was obtained as the thermal conductivity of the corrosion-product film. The results indicate that from a corrosion standpoint either 6061 or 1100 aluminum could be used as cladding material for the High-Flux Isotope Reactor fuel elements, provided the pH of the coolant is maintained at 5.0 to 5.3 with nitric acid. Under test conditions simulating the most severe conditions anticipated during operation of the reactor (hot spot–hot channel) the maximum penetration observed was only 1 mil in 10 days. Although somewhat excessive temperatures are probable at hot spots due to a high rate of corrosion-product buildup, the great majority of the fuel plates will operate at reasonable temperatures. (auth)

4500 (ORNL-TM-51) CATASTROPHIC OXIDATION OF HIGH-TEMPERATURE ALLOYS. J. H. DeVan (Oak Ridge National Lab., Tenn.). Nov. 10, 1961. Contract W-7405-Eng-26. 26p.

The growth of nonprotective, crust-like oxide films was encountered in high-temperature alloy systems that contain molybdenum, vanadium, or tungsten as strengthening additions. The cause of accelerated oxidation in such alloys appears to be associated with the characteristically low melting temperatures of oxides of these refractory elements. The factors that contribute to a breakdown of oxidation protection in these systems are outlined and remedial methods which may be used to avoid catastrophic oxidation are discussed. Commonly encountered service failures that have resulted from catastrophic oxidation are also described. (auth)

4501 (TID-13688) CORROSION INVESTIGATION OF "L" NICKEL UNDER FLUORINATION CONDITIONS. F. W. Fink, P. D. Miller, E. F. Stephan, and E. L. White (Battelle Memorial Inst., Columbus, Ohio). Sept. 15, 1961. Contract [W-7405-eng-92]. 16p.

The study shows that "L" Nickel is subject to corrosive attack under fluorinator conditions at 500°C. This attack is primarily intergranular with maximum metal loss taking place at the interface between liquid and vapor. On a weight loss basis, the calculated corrosion rate is similar to that for HyMu80 but less than that for INOR 8. Of the three candidate materials examined so far; INOR 8, HyMu80, and "L" Nickel, the HyMu80 appears to be superior. (P.C.H.)

4502 (TID-13691) CORROSION INVESTIGATION OF HyMu-80 UNDER FLUORINATION CONDITIONS. F. W. Fink, P. D. Miller, and E. F. Stephan (Battelle Memorial Inst., Columbus, Ohio). Sept. 1, 1961. Contract [W-7405-eng-92]. 12p.

Metallographic examinations of the specimens subjected to fluorination conditions for 148 hr at 500°C showed that the corrosion was general in nature and that there was only an occasional indication of intergranular attack. The study indicates that the material should be a prime candidate for consideration as a material for construction of fluorinator process equipment. There is some indication that the heat treated material is slightly more resistant than the as-received material. Weldments appear sound and free from selective attack. The results to date would permit rating HyMu-80 above nickel in durability because of the more severe intergranular attack on nickel. (B.O.G.)

4503 (TID-14242) STUDY OF THE KINETICS OF OXIDATION OF ZIRCONIUM–NIOBIUM ALLOYS AT LOW TEMPERATURES. Progress Report, February 1, 1961–October 31, 1961. O. Zmeskal and K. H. Lin (Toledo. Univ. Research Foundation). Contract AT(11-1)-1000. 24p.

In order to study the kinetics of the oxidation of zirconium–niobium alloys, a Kimax-and-Vycor reaction tube containing a quartz helix balance and the accessories were designed and built for measuring the rate of reaction by a gravimetric method. Important experiments carried out to date include: the calibration of the quartz helix balances at 25, 400, and 600°C in an oxygen stream under atmospheric pressure, the adjustment and calibration of the temperature controllers, and measurements of the rate of oxidation of pure zirconium at 400 and 600°C for varying periods of time up to 100 hours. Much difficulty was experienced in handling the quartz helix balance and in obtaining accurate measurements of weight changes. Therefore, considerable efforts were made to modify and improve the apparatus to overcome the difficulty. (auth)

4504 (VDIT-7.1) THE CORROSION OF ZIRCONIUM AND ZIRCONIUM ALLOYS IN WATER AND STEAM. A Literature Survey. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1961. 29p.

A bibliography of 74 references, most with abstracts, is presented on the aqueous corrosion of zirconium and zirconium alloys. Their date of publication ranges from the beginning of 1959 to the middle of 1961. (D.L.C.)

4505 ZIRCONIUM ALLOYS FOR USE IN SUPERHEATED STEAM. Sherman Greenberg (Argonne National Lab., Ill.). J. Nuclear Materials, 4: 334-5(Aug.-Sept. 1961). (In English)

The preliminary results of a program designed to develop suitable zirconium alloys for use in superheated steam are presented. The corrosion behavior of four of the best Fe–Zr alloys in superheated steam at 500°C and 600 psi in terms of weight gain is illustrated. Some directions for future work are also indicated. Investigation of the buildup of hydrogen in the metal during corrosion and its effect on properties is in a very preliminary stage. (P.C.H.)

4506 CORROSION OF METALS BY VAPOURS FROM ORGANIC MATERIALS. A SURVEY. Vera E. Rance and H. G. Cole. London, Her Majesty's Stationery Office, 1958. 25p. 2s.

A study was made of organic compounds, such as those that may be evolved from woods, glues, micro-organisms, varnishes, and plastics, which may cause corrosion of metals in restricted spaces. Instances of corrosion in service, classified according to source of vapor, are presented. Results from various laboratory tests are summarized. The rate of corrosion was found to be greatest under warm, damp, conditions. It was also found that the metals most susceptible to this type of corrosion are lead, cadmium, magnesium, and zinc. (M.C.G.)

Fabrication

4507 (ASD-TR-61-7-787a) WIDE, CLOSE-TOLERANCE STEEL SHEETS; SYMPOSIUM [HELD AT PACIFIC PALISADES, JUNE 27 AND 28, 1961]. Final Technical Engineering Report [for period] December 1959–June 1961. Bernard B. Moss, ed. (Douglas Aircraft Co., Inc., Santa Monica, Calif.). Oct. 1961. Contract AF33 (600)-42793. 580p.

Results of evaluation of wide, close-tolerance steel sheet handling, inspection, fabrication, and testing were presented at a symposium. The data presented indicated that wide steel sheets were produced with satisfactory metallurgical properties and to tolerances approximately half of the present standard width tolerances. Large diameter missile forward closures and aircraft bulkheads were formed from wide single sheets by explosive forming and shear forming. Missile motor cases which tested satisfactorily were produced by the roll-and-weld technique, from wide steel sheets using a single sheet in a 360° wrap. (auth)

4508 (BMI-1555) PROGRESS ON THE USE OF GAS-PRESSURE BONDING FOR FABRICATING LOW-COST CERAMIC, CERMET, AND DISPERSION FUELS. Final Report on AEC Fuel-Cycle Program. Stan J. Paprocki, ed. (Battelle Memorial Inst., Columbus, Ohio). Nov. 24, 1961. Contract W-7405-eng-92. 42p.

Development of techniques for the fabrication of Type 304 stainless steel-clad uranium dioxide fuel elements by the gas-pressure-bonding process was continued. More definite studies of the process operations directed toward establishing preliminary process specifications were undertaken. Both rod and compartmented flat-plate fuel geometries were considered. Individual operations were optimized with respect to their effects on the characteristics of the final bonded oxide. Prior to completion, these investigations were terminated in favor of fabrication of fuel rods for irradiation in the VBWR. The work during this phase demonstrated that fuel rods can be fabricated by pressure bonding using cold-pressed oxide fuel. Good dimensional control was achieved, and, in the case of the VBWR rods, the general specifications for a fuel rod designed for pelletized fuel were met by the pressure-bonding route. Compartmented flat-plate assemblies as processed by gas-pressure bonding also demonstrated good dimensional control. (auth)

4509 (DMIC-Memo-136) FABRICATION OF TUNGSTEN FOR SOLID-PROPELLANT ROCKET NOZZLES. R. I. Jaffee, D. J. Maykuth, and V. D. Barth (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 2, 1961. 29p.

Information on the consolidation and fabrication processes being used to produce large tungsten shapes and sheet, the general physical characteristics of the various types of tungsten being shaped into rocket nozzles, and the performance of these in solid-fuel rocket motors is summarized. Tungsten has adequate properties to withstand the thermal, chemical, and mechanical environments in many of the more advanced solid-propellant rocket systems. Tungsten may be used in rocket components in a number of forms, but the leading form is pressed, sintered, and forged unalloyed tungsten. Most of the successful firings of full-scale nozzles at 5500°F or higher were accomplished with inserts of this type. An unexpected factor, which may lead to increased use of sheet tungsten, is the good performance of welded metal. (P.C.H.)

4510 (DMIC-Memo-140) REVIEW OF RECENT DEVELOPMENTS IN METALS JOINING. J. J. Vagi, W. J. Lewis, and H. W. Mishler (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Dec. 6, 1961. 10p.

Developments in welding techniques for metals and alloys for high-strength applications (e.g., in rocket motor cases, submarine hulls, armor, etc.) are reviewed. The welding methods studied include tungsten-arc, ultrasonic, electron beam, fusion, resistance-spot, and flash techniques. The alloys studied include Ti-base alloys, alloyed with Al–Cr–V, Al–Sn, Al–V, Al–V–Zr, Al–Nb–Ta, or Al–Mo–V; Nb-base alloys; W metal; Mo–0.5% Ti alloy; steels and stainless steels; and Multimet N-155. (T.F.H.)

4511 (GA-2235) A PROGRAM OF RESEARCH ON MECHANICAL METALLURGY AS RELATED TO FUEL-ELEMENT FABRICATION. Summary Report to December 31, 1960. T. A. Trozera, J. L. White, K. Koyama, and R. H. Chambers (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 21, 1961. Contract AT (04-3)-167. 157p.

Investigations were carried out to determine the fabrication characteristics and mechanical properties of many of the structural materials considered for current and future applications in nuclear industries. The experimental approaches attempted to define formability in terms of the parameters of classical plasticity theory and to understand the relation between formability and the dislocation structures present in material by virtue of its mechanical and thermal history. The studies in mechanical metallurgy were directed primarily at the rigorous application of classical plasticity theory to rod drawing. Accurate determinations were made of the stress-strain curve for materials at every stage of the deformation process. The thermodynamic studies were concerned entirely with the characterization of imperfection structures by measurements of the stored energy associated with the dislocations and other crystal defects produced during deformation. A differential calorimeter was developed for the determination of the total stored energy, as well as the annealing spectrum of stored energy release. The studies in solid-state physics were aimed at obtaining experimental measurements of the behavior of dislocations in the imperfection structures generated by plastic deformation. Improved techniques of low-temperature acoustical relaxation spectrometry were applied to the study of dislocation behavior in the body-centered-cubic group of high-temperature structure metals. (M.C.G.)

4512 (LA-2591) FABRICATION OF TANTALUM CAPSULES BY IMPACT EXTRUSION AND IRONING. R. S. Kirby, G. S. Hanks, and J. M. Taub (Los Alamos Scientific Lab., N. Mex.). Jan. 1961. Contract W-7405-Eng-36. 56p.

The fabrication development is described for a tubular closed-end tantalum container ~9 in. long with an ID of ~0.375 in. and 0.020 in. to 0.030 in. wall. Impact extrusion techniques were used to form first a thick-walled cup which was subsequently ironed to the final shape. The material used for the initial investigation was prepared from tantalum powder; materials used later were high-purity electron-beam-melted tantalum and tantalum containing 0.1 wt % tungsten. Several impact extrusion steps were required to form the thick-walled cup. Subsequent ironing was done in six stages. Aluminum-bronze dies and a beeswax lubricant were used to prevent seizing and galling between the tools and the tantalum. Loads of 30 to 40 tons were used for the impact extrusion process. Draw pressure requirements for the ironing operation ranged from 600 lb to 3600 lb. The Ta + 0.1 wt % W material consistently required higher impact extrusion and draw pressures than the high-purity material. The development showed that heat-treating procedures had a considerable effect on the surface finish. In general, tantalum was found to be quite compatible with this method of fabrication. (auth)

4513 (NAA-SR-6454) FABRICATION AND PROPERTIES OF TRANSLUCENT BERYLLIUM OXIDE. J. D. McClelland, J. H. Richardson, and L. R. Franklin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 30, 1961. Contract AT(11-1)-GEN-8. 17p.

The techniques by which translucent beryllia was hot pressed are described. Sizes ranging as great as 5 inches in diameter and 1 inch thick were fabricated with both high purity beryllia and beryllia doped with magnesia. Density of the material ranges above 99.5% of theoretical. Microstructure studies indicated that the material is characterized by complete removal of grain boundary porosity. Preliminary data on the infrared transmission, the mechanical strength and creep, and the thermal conductivity are presented. It was concluded that the thermal and mechanical properties of fully densified, translucent BeO which are pertinent to performance under high-temperature mechanical loads and thermal stresses are substantially superior to those of opaque BeO ceramics. (auth)

4514 (NMI-ABB-1) PROCESS SEQUENCE FOR THE FABRICATION OF HWCTR DRIVER TUBES. A. B. Bremer, E. F. Jordan, and W. Macdonald (Nuclear Metals, Inc., Concord, Mass.). Sept. 20, 1960. Contract AT(30-1)-1565. 120p.

The fabrication of driver tubes for the Heavy Water Components Test Reactor is described. The tube assembly consists of a Zr–9.3 wt.% U (93 wt.% enriched) core, with a Zr cladding and a Cu can. The core is made by induction melting U and Zr together. The fabrication process entails assembly of the prefabricated components, and extrusion of the assembly to form the desired tube. The economic aspects of the process are detailed. (T.F.H.)

4515 (NP-11054) FUNDAMENTALS OF ULTRASONIC WELDING, PHASE II. Final Report, December 1, 1958–February 1, 1960. J. Byron Jones, Nicholas Maropis, John G. Thomas, and Dennison Bancroft (Aeroprojects Inc., West Chester, Penna.). Dec. 1960. Contract NOas 59-6070-c. 183p. (RR-60-91)

An extension is given of earlier research which developed instrumentation and techniques to permit the work reported. Photoelastic investigations show that ultrasonic welds are initiated as a result of vibration-induced interfacial shear stresses combining with the interfacial shear stresses resulting from the normal clamping force to produce alter-

nately, on the side toward which the vibratory force acts, islands of local slip within an area of elastic strain. A proper clamping force is productive of a best impedance match to effect energy delivery into the weld locale. Sheet thickness and the Vickers microhardness indentation number are combined to permit a first approximation of the energy required to produce welds between metallic sheets. Optical and electron microscope observations and pertinent discussion are presented. Autoradiographic techniques are used to follow surface film dispersion, and it is suggested that dispersion strengthening may be associated with ultrasonic welds. Bonds are not uncommonly characterized by internal deformations without significant external deformation. Recrystallization can occur in ultrasonic welds, but does not appear to be a common denominator. The temperature achieved during vibratory welding is measured to be in the range of about 35 to 50% of the absolute melting temperature. No evidence of melting was observed in any monometallic weld. (auth)

4516 (NP-11126) SOME EXPERIENCES IN THE WELD FABRICATION OF REFRACTORY METALS. Ernest G. Thompson (Marquardt Corp., Van Nuys, Calif.). Feb. 10, 1961. 35p. (S-190)

Discussion is given on the welding fabrication of tungsten, molybdenum, niobium, and tantalum. Properties which make the four refractory metals important are tabulated along with titanium which is given for comparison. Extensive evaluation was conducted using the gas, tungsten arc welding process employing both manual and machine welding. Design data were obtained exclusively from machine welded sheet materials. Flash welding, resistance spot welding and brazing, electron beam welding, and high frequency resistance welding processes were also applied to molybdenum alloys. The oxidation of molybdenum, tantalum, and niobium in flowing air at 2000°F is also given. (P.C.H.)

4517 (NP-11128) EVALUATION OF ELECTRON BEAM WELDING OF ALLOYED MOLYBDENUM SHEET. E. G. Thompson, E. C. Bernett, and H. Binder (Marquardt Corp., Van Nuys, Calif.). Feb. 17, 1961. 37p. (S-192)

For presentation at the 1961 Western Metals Conference.

The results of a program conducted to evaluate the electron beam welding process as applied to alloyed molybdenum sheet are given. Both low and high voltage welding equipment were utilized in the study. This enabled comparison of results to see if either type of equipment had distinct advantages. Welded test panels were evaluated radiographically, metallographically, and mechanically. The tensile properties at temperatures up to 3200°F were obtained for both the welded specimens and parent material. Testing was conducted on uncoated specimens using a protective atmosphere. (auth)

4518 (WADD-TR-60-418(Pt.II)) DEVELOPMENT OF OPTIMUM METHODS FOR THE PRIMARY WORKING OF REFRACTORY METALS. R. W. Tombaugh, R. C. Green, and J. H. Gehrke (Harvey Aluminum, Torrance, Calif.). June 1961. Contract AF33(616)-6377. 219p.

The development of new processes and techniques for the primary working of refractory metal alloys by hot extrusion is described. The process developed during the first years' work was considerably improved and was used successfully in extruding refractory metals at temperatures above 4000°F. This required the development of improved high temperature billet lubrication, novel die designs utilizing ceramic facing materials, high temperature heating facilities, and methods for accurately sensing billet temperatures. The suitability of the process was established by metallurgical evaluation of extruded materials which demonstrated a high degree of amenability to subsequent reworking by conventional methods. In addition, the extrusion process as developed was applied to a wide variety of refractory metal alloys and was useful in providing a substantial quantity of wrought materials. (auth)

4519 ISOSTATIC SOLVENT PRESSING. Paul B. Archibald (Univ. of California, Livermore). Ind. Eng. Chem., 53: 737-8(Sept. 1961). (UCRL-6219)

The two techniques, isostatic pressing and solvent pressing, were combined in order to utilize the special advantages of each system. The special apparatus consists of an open-end Neoprene bag into which is inserted a metal chamber (heavy wall tube) fitted across the mouth with a perforated metal plate. In operation, solvent is placed in the Neoprene bag, powder is poured in, and the chamber is inserted. The assembly is then subjected to isostatic pressure. In addition to the geometry and size of the piece to be pressed, other parameters of significance are press time, pressure, temperature, particle size and size distribution, and solvent. Discussion is given on the pressing of explosives and propellant formulations. (P.C.H.)

4520 LIQUID OXIDE PHASE SINTERING OF MOLYBDENUM AND TUNGSTEN. W. H. Lenz and J. M. Taub (Los Alamos Scientific Lab., N. Mex.). J. Less-Common Metals, 3: 429-32(Oct. 1961). (In English)

In the hydrogen sintering of Mo and W at about 1700°C, compacts containing minor amounts of TiO_2 combined with UO_2 or ThO_2 will permit the sintered density to approach theoretical. The combination of these oxides appears to result in a phase which is liquid at the sintering temperature, and wets Mo and W. (auth)

4521 FABRICATION DEVELOPMENT OF APM FUEL ELEMENTS FOR ORGANIC COOLED REACTORS. E. G. Kendall (Aerospace Corp., El Segundo, Calif.), G V. Alm, W. H. Friske, M. H. Binstock, B. N. Briggs, and B. Gradle. Nuclear Eng., 6: 525-30(Dec. 1961).

Strength at high temperature, high thermal conductivity, low neutron absorption, and good corrosion resistance make aluminum powder metallurgy (APM) alloys especially suitable for cladding and structural materials for organic cooled and moderated reactor fuel elements. Fabrication techniques developed for the APM alloys are described and they include such methods as conventional forging, rolling, and extrusion processes. The principal properties and the diffusion bonding method for joining the APM alloys are also discussed. (N.W.R.)

4522 IMPROVEMENTS IN METHODS OF PREPARING SINTERED BERYLLIUM OXIDE PRODUCTS. (to Commissariat à l'Énergie Atomique). British Patent 884,577. Dec. 13, 1961.

A method is outlined for producing sintered beryllium oxide shapes, e.g., bricks, for use as neutron shields. The method comprises adding 1% mineral acid or a beryllium salt thereof to beryllium hydroxide, calcining, adding a small amount of a neutron-absorbent compound, and sintering the mixture to form masses which are very dense, homogeneous and free from defects. The neutron-absorbent material may be boron carbide, boric hydroxide, or cadmium oxide. Examples of the method are given in which beryllium oxide bricks were made with 10 cm × 10 cm × 5 cm dimensions. (D.L.C.)

4523 METHOD FOR COATING GRAPHITE WITH NIOBIUM CARBIDE. James S. Kane, J. H. Carpenter, and O. H. Krikorian (to U. S. Atomic Energy Commission). U. S. Patent 3,017,286. Jan. 16, 1962.

A method is given for coating graphite with a hard, tenacious layer of niobium carbide up to 30 mils or more thick. The method makes use of the discovery that niobium metal, if degassed and heated rapidly below the carburization temperature in contact with graphite, spreads, wets, and penetrates the graphite without carburization. The method includes the obvious steps of physically contacting niobium powders or other physical forms of niobium with graphite, degassing the assembly below the niobium melting point, e.g., 1400°C, heating to about 2200 to 2400°C within about 15 minutes while outgassing at a high volume throughput, and thereafter carburizing the niobium. (AEC)

4524 METHOD OF MAKING DELTA ZIRCONIUM HYDRIDE MONOLITHIC MODERATOR PIECES. James B. Vetrano (to U. S. Atomic Energy Commission). U. S. Patent 3,018,169. Jan. 23, 1962.

A method is given for preparing large, sound bodies of delta zirconium hydride. The method includes the steps of heating a zirconium body to a temperature of not less than 1000°C, providing a hydrogen atmosphere for the zirconium body at a pressure not greater than one atmosphere, reducing the temperature slowly to 800°C at such a rate that cracks do not form while maintaining the hydrogen pressure substantially constant, and cooling in an atmosphere of hydrogen. (AEC)

Properties and Structure

4525 (AERE-R-3850) POLISHING AND ETCHING TECHNIQUES FOR SURFACES OF THERMALLY-SHOCKED ALUMINIUM OXIDE. R. C. McVickers, S. D. Ford, and R. A. Dugdale (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1961. 13p.

Techniques for polishing and etching high purity alumina are described. For sections through thermally shocked surfaces, it is necessary to glaze the surface to ensure the damage features are retained during the polishing and, etching procedure. The use of Hyprocel paper laps helps to preserve the edges of the material during polishing, and gives a reduction in plucking in the rest of the surface. Four techniques for etching dense alumina are described; for convenience and control either sulfuric or phosphoric acid is recommended. (auth)

4526 (D1-82-0103) PRESSURE DEPENDENCE OF ELASTIC VIBRATIONS IN ALKALI METALS. Joachim C. Erdmann (Boeing Scientific Research Labs., Seattle). Apr. 1961. 27p.

The pressure dependence of the elastic constants, the sound velocities, and sound polarization for alkali metals were calculated based on simple assumptions resulting from the theories of Fuchs and Gombas on the elastic shear and bulk moduli. The results are found to be in essential agreement with recent experiments and investigations made previously on sodium. The pressure derivative of the bulk modulus is nearly exactly the same as the experimental value, whereas the pressure derivatives of the shear moduli differ from the experimental values by a factor of 2. The theoretical ratio of the pressure derivatives of the shear moduli, however, is much the same as the corresponding experimental value. (auth)

4527 (DMIC-160) INTRODUCTION TO METALS FOR ELEVATED-TEMPERATURE USE. J. E. Campbell, H. B. Goodwin, H. J. Wagner, R. W. Douglass, and B. C. Allen (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 27, 1961. Contract AF18 (600)-1375. 92p.

The general categories of metals suitable for application at temperatures in excess of 800°F are discussed, along with the general advantages and limitations of each. Some generalized mechanical and physical property data are included, and the problems of reactions at elevated temperatures are briefly discussed. (auth)

4528 (DMIC-Memo-134) MACHINING OF SUPERALLOYS AND REFRACTORY METALS. C. T. Olofson and F. W. Boulger (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 27, 1961. 52p.

A review is presented of the machining properties of superalloys and refractory metals. The superalloys consist of chromium, nickel, and iron as base metals with cobalt, molybdenum, tungsten, titanium, and aluminum present in groups of two or more to form the different alloys. The refractory metals include niobium, molybdenum, tantalum, tungsten, and their alloys. A comparison is given of service temperatures for these alloys with other space-age metals. (B.O.G.)

4529 (DMIC-Memo-138) REVIEW OF RECENT DEVELOPMENTS IN THE TECHNOLOGY OF BERYLLIUM. Webster Hodge (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Nov. 16, 1961. 6p.

An indication is given of the controls of particle size, degree of oxidation, and over-all purity required in powder metallurgy of Be. The results of an attempt to produce pure Be by distillation are outlined. Tensile tests performed on Be single crystals are examined. Techniques for joining Be by resistance welding are discussed. The changes in the mechanical and physical properties of Be that are caused by the (n,2n) and (n,α) reactions are studied, and the effects of the He produced in the metal by the latter process are described. (T.F.H.)

4530 (NAA-SR-6125) ISOTHERMAL TRANSFORMATION OF U–14 AND U–16 WT % Mo ALLOYS AT 550°C. Interim Report. W. A. Holland (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-GEN-8. 17p.

Isothermal transformation kinetics studies of nominal U–14 and U–16 wt % Mo alloys were carried out to determine the limits of gamma-phase stability in these alloys at 550°C. Vacuum induction melted and homogenized samples were gammatized in vacuum at 900°C for 72 hr and ice-water quenched. The gamma phase was retained in each sample. The gammatized samples were then isothermally heat treated in vacuum for specified intervals, ice-water quenched, and examined by x-ray diffraction, metallographic, and microhardness techniques for evidence of transformation. The retained and metastable gamma phase in U–14 and U–16 wt % Mo alloys began to transform to the alpha plus gamma prime and gamma prime phases after 20 and 16 hr, respectively, as indicated by x-ray diffraction and metallography. However, a transition phase, believed to be of alpha phase U–Mo, appeared in the alloys after 0.3 hr in U–14 Mo and 0.1 hr in U–16 Mo. A plot was made of the variation in time at 550°C for the beginning of equilibrium transformation and molybdenum content. U–10 wt % Mo alloys are more gamma stable at 550°C than other alloys in the range of about 5 to 16 wt % Mo. However, U–16 wt % Mo alloys transform to a stable gamma prime equilibrium phase, a promising structure for high temperature, high burnup reactor service. (auth)

4531 (NAA-SR-6291) OUTGASSING EXPERIMENTS WITH MOLDGRADE GRAPHITE FOR THE HNPF. J. J. Gill (Atomics International. Div. of North American Avi-

ation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-GEN-8. 38p.

The outgassing characteristics of various mold grade graphites were determined, under static and dynamic tests. Several nuclear grades were tested for comparison. The mold grades were found to contain between 0.6 and 1.2 cm^3 total gas (STP) per cm^3 of graphite, approximately two to three times more gas than the nuclear grades. At the graphite temperatures expected in the Hallam Nuclear Power Facility, it was found that mold grade graphites could be sealed in stainless steel capsules without pressure buildups exceeding 1 atm. The gases released from the graphite were found to react with the stainless steel at 650°C. No differences were observed between samples of similar grades of graphite manufactured by different vendors. (auth)

4532 (NAA-SR-6617) THE GAMMA TO GAMMA PRIME TRANSFORMATION IN THE URANIUM–MOLYBDENUM SYSTEM. D. Kramer and C. G. Rhodes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 30, 1961. Contract AT(11-1)-Gen-8. 23p.

Electrical resistance measurements and metallography were employed in a study of the kinetics of the gamma to gamma prime transformation in the uranium-molybdenum system at 16 wt % molybdenum. A non-equilibrium phase, identified x-ray diffraction as alpha uranium, appeared early in the transformation anneal, reaching a maximum volume fraction at the time the gamma prime emerges. Subsequently, the alpha phase disappeared with time. The gamma matrix transformed to gamma prime faster as the transformation temperature was increased; at 550°C, the gamma prime phase first appeared between 48 and 72 hours, while at 500°C it first appeared after a 120 hour anneal. (auth)

4533 (NDA-2119-1) THE PREPARATION AND PROPERTIES OF DISPERSION-HARDENED URANIUM POWDER PRODUCTS. W. Arbiter (Nuclear Development Corp. of America, White Plains, N. Y.). Feb. 21, 1961. Contract AT(30-1)-2303. 35p.

A method for producing fine, surface-oxidized uranium powder with a controlled amount of oxide was developed. The improved double oxidation method, which gave accurate control of the oxide content, is summarized as follows: hydriding uranium shot, partial oxidation of the finely divided hydride, decomposition of the hydride, and completion of the oxidation. The method for hot pressing and extruding these powders in vacuum, developed and refined, was used to produce 25 extrusions of dense, dispersion-hardened uranium–uranium oxide material of various oxide contents. Thermal cycling tests through α/β transformation temperature showed that sintered uranium powder (SUP) containing more than about 8 vol % of UO_2 was superior to wrought, unalloyed uranium metal. Hot indentation tests indicated that SUP with high oxide content has substantially better hardness than unalloyed uranium and about the same hardness as U–10 wt % Mo. The creep resistance of SUP as determined in hot bend tests, was also superior to that of unalloyed uranium. (P.C.H.)

4534 (NP-11088) ENGINEERING PROPERTIES OF POTASSIUM. Fourth Quarterly Report, July 1–September 30, 1961. Alexis W. Lemmon, Jr. (Battelle Memorial Inst., Columbus, Ohio). Oct. 30, 1961. Contract NAS-5-584. 22p.

Several items of equipment are ready for experimental measurements to begin and other items are nearing completion. The equipment ready for operation includes the low-temperature boiling point apparatus for measuring vapor pressure, the Bunsen ice calorimeter for measuring the specific heat of liquid, and the oscillating-cylinder viscometer for determining the viscosity of liquid potassium. Apparatus for measuring the thermal conductivity of liquid and the P-V-T equipment should be in operation in a short time. Equipment for the measurement of specific heat and viscosity of vapor is still in the design stage. Preliminary values for the specific heat of liquid up to 1152°C are given in this report. Progress has been made in developing equipment and procedures for purification of potassium, although the first purified potassium contained more oxygen than is desired for the experimental measurements. It is expected that subsequent distillations will be successful in reducing the oxygen level to an acceptable value. Difficulties have been encountered in using Nb–1Zr alloy with potassium at high temperatures. A notable example of this difficulty was the failure of one of the thin-walled specific heat capsules at about 2100°F. Metallographic examination indicated that poor material quality as well as the failure to anneal prior to use were the prime causes of the failure. Rigid specifications for this material as well as proper procedures for machining, welding, and annealing are being established. A boiling-point apparatus of stainless steel has been fabricated and assembled to investigate the effect of thermocouple position within or above the boiling potassium on the observed temperature. When the proper thermocouple position has been established, apparatus will be fabricated from Nb–1Zr. Consideration of the proposed transpiration measurements indicated that the desired information regarding vapor-phase composition will not be obtainable with sufficient accuracy. Other techniques for obtaining this information are being explored. Enthalpies of solid and liquid potassium at 32 to 2100°F have been determined experimentally. However, because the calorimeter capsule failed, sufficient data were not obtained; only the raw enthalpy data are reported. The fabrication of the second thermal conductivity cell has been suspended pending clarification of the proper procedures for using the Nb–1Zr alloy. A gas viscometer based on the capillary-flow principle is being considered for the measurement of the viscosity of potassium vapor. The recent literature has been reviewed, and design of the apparatus is in progress. The oscillating-cylinder viscometer for the measurement of the viscosity of liquid potassium is ready for operation. The comparative method for calibration has been discarded in favor of an absolute calculational technique for obtaining viscosity values. A computer program is being written to perform the complex iteration required to obtain these results. Assembly and calibration of the P-V-T apparatus is continuing. It is expected that the furnace will be constructed and the equipment calibration completed during the next report period. A flow calorimeter is being considered for the determination of the specific heat of potassium vapor. An analysis shows that high flows and temperature differences will be required to obtain accuracy above that obtained from spectroscopic data. It is concluded that the construction and operation of a flow calorimeter is the only way to resolve the question of whether or not sufficient accuracy can be obtained. (auth)

4535 (NP-11092) BIBLIOGRAPHY OF HIGH TEMPERATURE CONDENSED STATES RESEARCH IN CANADA AND ELSEWHERE, JANUARY–MARCH 1961. Norman F. H. Bright (Canada. Dept. of Mines and Technical Surveys, Mines Branch). June 1961. 89p.

Available as Can. Dept. Mines Tech. Surveys, Mines Branch Inform. Cir. IC-128. $0.25.

Bibliographic information is presented on high-temperature research. It contains information concerning high-temperature condensed states research published in Canadian journals during the period January to March, 1961. Also included are bibliographies of work in this field published in Austria, Germany, France, and Belgium, Great Britain, Scandinavia, the United States and the U.S.S.R. during the period October to December, 1960, and in Australia during the period January to September, 1960. Brief mention is made of the XVIIIth International Congress of Pure and Applied Chemistry to be held in Montreal, Que., in August, 1961. (542 references.) (auth)

4536 (NP-11093) BIBLIOGRAPHY OF HIGH TEMPERATURE CONDENSED STATES RESEARCH IN CANADA AND ELSEWHERE, APRIL–JUNE 1961. Norman F. H. Bright (Canada. Dept. of Mines and Technical Surveys. Mines Branch). July 1961. 100p.

Available as Can. Dept. Mines Tech. Surveys, Mines Branch Inform. Cir. IC-130. $0.25.

Bibliographic information is presented on high-temperature condensed states research. It contains references to papers in this field published in Canadian journals during the period April to June, 1961. Also included are bibliographies of such work published in Australia, Austria, France and Belgium, Germany, Great Britain, the Netherlands, Scandinavia, the United States and the U.S.S.R. during the period January to March, 1961. (614 references.) (auth)

4537 (NP-11127) PROPERTIES OF FLASH WELDED MOLYBDENUM. Ernest G. Thompson, Harold Binder, and Harold Collins (Marquardt Corp., Van Nuys, Calif.). Feb. 17, 1961. 35p. (S-191)

For presentation at the 42nd annual meeting of the American Welding Society, New York, 17 to 21 April, 1961.

A technique for flash welding arc-cast, 0.5% titanium–molybdenum alloy bar stock was developed. The as-welded properties of the joint were determined at room temperature. Flash welded bars were processed into sheet material and the properties of the cold-worked specimens obtained over the temperature range of 2200 to 3200°F. The feasibility of applying the flash welding process to the fabrication of molybdenum alloy rings and cylinders was demonstrated. Such parts can be used as structural members, or, more importantly, as preforms for production of hardware by metal-moving techniques. (auth)

4538 (NP-11147) THE DETERMINATION OF THE SUITABILITY OF ALUMINUM CONTAINERS FOR THE PACKAGING OF IRRADIATED FOODS. Report No. 6 (Final), November 29, 1958–July 28, 1961. A. G. Skibbe (Continental Can Co., Inc., Chicago). Contract DA19-129-QM-1327. 17p.

Five food products, whole kernel corn, green beans, phosphate cured ham, tuna chunks, and peaches were packed in aluminum and tinplate cans, irradiated to a dosage level of 5.0 megarads, and stored for one year at 77 and 100°F. Samples from the same lots of cans were thermal processed as controls. All enameled aluminum containers performed satisfactorily with the five foods when irradiated or thermal processed. The irradiation treatment appeared to have less effect on the enamels as measured by a lesser amount of darkening and staining and fewer micro-blisters as compared to the thermal process treatment. The tinplate variables performed satisfactorily for all but ham when irradiated or thermal processed. In the case of ham packed in enameled tinplate cans, the irradiated samples were satisfactory while the thermal processed cans showed some loss of enamel, adhesion peeling, blisters, and corrosion at the drawn corners of the cans. Irradiation caused considerable hydrogen formation in all the products as determined by headspace gas analyses. (P.C.H.)

4539 (NP-11151) NEW STEELS DEVELOPED FOR REACTOR PRESSURE VESSELS. Progress Report on Britain's Programme of Nuclear Power. Nuclear Engineering in the United Kingdom—No. 3. E. N. Shaw. [1961]. 8p.

Developments in the steels for reactor pressure vessels and further progress in Britain's nuclear power program are discussed. Topics discussed include steels for reactors, new steels developed, Dounreay operation, the Sizewell reactor, the Severn Magnox Station, steel versus concrete, Britain's eighth nuclear power station, manufacture of radioisotopes, radiation research, and industrial process control. (M.C.G.)

4540 (NP-11154) THE ELECTROLYTIC POLARIZATION OF BERYLLIUM. D. J. Levy (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Nov. 1961. 18p. (LMSC-6-90-61-75)

The anodic and cathodic polarization behavior of beryllium was determined in a number of unstirred aqueous electrolytes at 22°C with current densities in the range of 10^{-7} to 10^{-2} amps/cm^2. CrO_4^{2-} and PO_4^{3-} induced considerable anodic polarization. There was some evidence that the anodic potential was increased due to BeO film formation in the presence of CrO_4^{2-}, NO_3^-, and AlO_2^-. A Flade Potential was not observed. Beryllium was activated and attacked anodically in the presence of Cl^-, ClO_3^-, F^-, and SO_4^{2-}. Other ions investigated were $B_4O_7^{2-}$, $C_2H_3O_2^-$, CO_3^{2-}, MnO_4^-, OH^-, and SiO_3^{2-}. Na_2CrO_4 was an effective cathodic polarizer over a broad range of current densities. Most of the electrolytes exhibited a common Tafel region for hydrogen evolution. Some corrosion aspects of the solutions are also discussed. (auth)

4541 (NP-11159) PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM. Bi-Monthly Progress Report, September 2–November 1, 1961. G. E. Spangler, M. Herman, V. V. Damiano, E. J. Arndt, and D. B. Hoover (Franklin Inst. Labs. for Research and Development, Philadelphia). Contract NOw-61-0331-d. 14p. (P-A2476-6)

The zone refining of one-inch diameter Brush vacuum cast beryllium bar was continued, along with the zone refining of smaller diameter vacuum distilled and Pechiney SR grade bars. Three single crystal specimens of varying purity content were tested in tension. Vacuum distilled material which was subsequently zone melted seven passes exhibited a value of 400 psi for the critical resolved shear stress on the basal plane. Additional zone melted polycrystalline was prepared by hot rolling and recrystallizing four pass single crystal beryllium. Two different orientations with respect to the rolling plane were used. Tensile tests and bend tests were performed, but the results were inconclusive. Preliminary examinations were made of zone refined beryllium by electron transmission microscopy. It was observed that the dislocations do not move under the influence of the electron beam alone as they were observed to move in other metals. When the specimen was heated to 200°C, however, and cycled over a narrow range of temperatures, a slow movement of the dislocations was observed. (auth)

4542 (NP-11160) DEVELOPMENT OF ULTRA REFRACTORY MATERIALS. Summary Report, November 1, 1960–October 31, 1961. Peter T. B. Shaffer and Richard L.

Watts (Carborundum Co. Research and Development Div., Niagara Falls, N. Y.). Nov. 30, 1961. Contract NOrd-17175. 48p.

Room temperature investigations of various physical, mechanical and electrical properties of solid solutions of tantalum carbide and zirconium carbide showed no evidence of discontinuous changes indicating new phases or compound formation after a wide variety of annealing treatments. Emissivity studies indicate the probable existence of high-temperature phases of both tantalum carbide and zirconium carbide, though not of the solid solutions. The reported increase in melting temperature of ZrC–TaC solid solutions has been confirmed. Preliminary studies indicate that Lithafrax low expansion lithium aluminum silicate has a thermal shock resistance factor more than twice as great as Pyroceram 9606 and more than four times as great as alumina. Electrical properties, with the possible exception of dissipation factors, are within acceptable limits. Similar lithium aluminum silicate compositions with effectively zero expansion are known. These would, therefore, have infinite thermal shock resistance factors. (auth)

4543 (NRL-5704) ANOMALOUS FRACTURE IN THE CREEP OF NICKEL. T. C. Reuther, P. Shahinian, and M. R. Achter (Naval Research Lab., Washington, D. C.). Nov. 1, 1961. 13p.

Nickel and nickel-base alloys creep tested at relatively high temperature and low stress sometimes fail in the fillet where stress is appreciably less than in the gage section. This behavior is observed to occur in air, but never in vacuum. In the investigation of this anomaly, tapered nickel rods creep tested at 1200° and 1500°F fractured at the minimum diameter section in all vacuum and mildly oxidizing air tests. However, under strongly oxidizing conditions—long times in air at 1500°F—the fracture position was progressively displaced into heavier sections as the applied stress was reduced. Similarly, conventional specimens of different diameters creep tested at the same stress revealed that fracture may occur sooner in larger sections. Metallographic studies showed that under highly oxidizing creep conditions nickel is strengthened by the formation of load-bearing oxide which bridges intergranular cracks. A more extensive penetration of oxidized surface cracks causes this strengthening effect to be greater in the smaller sections than in the larger. The subsequent formation of a large network of oxide-free internal cracks in the larger sections leads to failure. The anomalous fractures are explained on the basis of the relative extent of oxide-filled and oxide-free cracks in small and large diameter sections of the specimens. (auth)

4544 (TID-3560) REFRACTORY MATERIALS. A Literature Search. (American Society for Metals, Novelty, Ohio). SUBJECT INDEX by Richard J. Smith (Division of Technical Information Extension, AEC). Nov. 1961. 234p.

A bibliography of 1704 references to reports and journal articles on refractory and related materials is presented. The period covered was 1958 through 1960. Author and subject indexes are included. (M.C.G.)

4545 (TID-14358) REPORT OF DRY RUNNING TWO 440-C HEAT-TREATED STAINLESS STEEL ANNULAR BALL BEARINGS IN A HELIUM ATMOSPHERE AT 510°F TEMPERATURE. R. J. Stuart, Jr. (Messinger Bearings, Inc., Philadelphia). Sept. 1961. For Baldwin-Lima-Hamilton Corp., Philadelphia. Contract AT(30-1)-2190. 46p.

The results of rotating a 440°C heat-treated air-melted stainless steel, full complement, annular ball bearing under 1170 lbs radial loading at low speed in a helium atmosphere at a temperature of 510°F are given. The two test bearings were operated under load for 85,400 revolutions in 358 hr at an average speed of 4 revolutions per minute. The tests were terminated when the shaft locked and the protective shear-pin drive coupling parted. Photographs of test equipment and the bearings after testing are given. The data are presented in tabular form. (M.C.G.)

4546 (TID-14359) REPORT OF DRY RUNNING TWO 440-C HEAT TREATED STAINLESS STEEL ANNULAR BALL BEARINGS IN A HELIUM ATMOSPHERE AT 510°F. TEMPERATURE. R. J. Stuart, Jr. (Messinger Bearings, Inc., Philadelphia). Oct. 1961. For Baldwin-Lima-Hamilton Corp., Philadelphia. Contract [AT(30-1)-2190]. 45p.

The results of rotating a 440°C heat-treated air-melted stainless steel, full complement, annular ball bearing under 1170 lb radial loading at low speed in a helium atmosphere at a temperature of 510°F are presented. The two test bearings were operated under load for 121,400 revolutions at an average speed of 4 rpm. The test was terminated after the required time of 500 hr was attained. Photographs are presented which show the test bearings after removal from the machine. Data are presented in tables and graphs. (M.C.G.)

4547 (WADC-TR-59-595(Pt.II)) METALLURGICAL AND MECHANICAL CHARACTERISTICS OF HIGH-PURITY TITANIUM-BASE ALLOYS. Albert G. Imgram, Dean N. Williams, Richard A. Wood, Horace R. Ogden, and Robert I. Jaffee (Battelle Memorial Inst., Columbus, Ohio). Feb. 15, 1960. Contract AF33(616)-5462. 119p.

The relationships between mechanical properties, alloy composition, microstructure, and thermal history were studied for high-purity titanium-base alloys. The alloy systems investigated include Ti–Al, Ti–Zr, Ti–Hf, Ti–Al–Zr, Ti–Al–Hf, Ti–Al–Cb, Ti–Cb, Ti–W, Ti–V–Cr, and Ti–V–Cr–Al. Mechanical-property data, including tensile and flow properties, impact behavior, hardness, aging, and cooling-rate data were determined. The metallurgical principles involved are discussed. (auth)

4548 (WADC-TR-59-744(Vol.VII)) INVESTIGATION OF FEASIBILITY OF UTILIZING AVAILABLE HEAT RESISTANT MATERIALS FOR HYPERSONIC LEADING EDGE APPLICATIONS. VOLUME VII. OXIDATION RESISTANCE OF BARE AND COATED MOLYBDENUM ALLOY AND GRAPHITE. Donald J. Powers, John A. Dickson, Joseph C. Conti, and Frank M. Anthony (Bell Aerosystems Co., Buffalo). Oct. 1960. Contract AF33(616)-6034. 207p. (AD-257732)

An investigation was made of the feasibility of utilizing available heat-resistant materials in the fabrication of leading edges for hypersonic gliders. The results are presented of oxidation-resistance tests of bare and coated 0.5% Ti–molybdenum alloy and ATJ graphite. Chromalloy W-2 and Durak MG coatings were evaluated on the molybdenum alloy while the ATJ graphite was coated by the National Carbon Company's siliconizing process. Tests were conducted in five different facilities including three arc plasma jets. Specimen temperatures were 2000 to 3400°F. Test times ranged from approximately 1 minute to 4 hours. (auth)

4549 (WADD-TR-59-95(Pt.III)) RESEARCH ON SYNTHESIS OF 1000°F STABLE BASE FLUIDS. James W. Dale, Elizabeth A. McElhill, Gerald J. O'Neill, Paul G. Scheurer, and Glenn R. Wilson (Monsanto Research Corp. Boston Labs., Everett, Mass.). Feb. 28, 1961. Contract AF33(616)-6851. 90p.

With the ultimate objective of developing 1000°F ther-

mally stable fluids, work was continued under two broad divisions into fluorine and non-fluorine systems. In the fluorine aspects, effort was concentrated in one approach on the synthesis of a limited number of perfluoropolyaromatic compounds with isolation of their perfluorocyclohexyl analogues as essential intermediates; the latter are of potential interest as thermally stable entities in their own right. In the preparation of these perfluorocyclohexyl derivatives considerable effort is required to eliminate hydrogen-containing impurities and other perfluorinated structures so as to make their thermal stability assessment significant. For this reason, additional stability data on the perfluoro derivatives are meager, but such as were obtained confirmed the high stability (1000°F) previously determined for representative compounds. Under the non-fluorine program, synthesis of model "building block" compounds, generally of aromatic structure, was continued with considerable thermal stability data being accumulated. This part of the program generally placed increasing emphasis on the synthesis and stability assessment of condensed and low polymeric systems made from such building blocks. (auth)

4550 (WADD-TR-60-893) RESEARCH AND DEVELOPMENT ON HIGH-PRESSURE-HIGH-TEMPERATURE METALLURGY. L. Kaufman, S. V. Radcliffe, S. A. Kulin, M. Shatz, J. Kafalas, L. E. Tanner, H. Bernstein, A. Leyenaar, and J. S. Harvey (Manufacturing Labs., Inc., Cambridge, Mass.). Contract AF33(616)-6837. 156p. Feb. 7, 1961.

Experimental investigations on the effect of high hydrostatic pressure on phase transformations in various substitutional iron-base alloys, with e.g. including chromium, nickel, and silicon, yield data in agreement with theoretical prediction. A study of the effects of pressure on iron-carbon alloys shows a general shift of the equilibrium phase boundaries to lower carbon contents and temperatures with pressure. Pressure also acts to retard both the rate of tempering and the isothermal transformation of metastable austenite. The synthesis of f.c.c. MoC is carried out at pressures in excess of 35 kilobars as 2000°C. The thermally activated recovery and recrystallization processes are shown to be retarded in a study of copper and 70-30 brass. Experimental data are obtained for the effect of pressure on the Hall voltage of cerium. Preliminary studies are carried out on the high pressure sintering of Al_2O_3. (auth)

4551 (WADD-TR-60-904) MEASUREMENT OF THERMAL PROPERTIES. I. B. Fieldhouse and J. I. Lang (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 15, 1960. Contract AF33(616)-6324. 119p.

The thermal conductivity, specific heat, and linear coefficient of thermal expansion were measured for the following materials: stainless steel types 420 and 17-4 PH, crucible HNM, AM 355, titanium C110M, Inco-713C, Haynes Stellite HE 1049, Kennametal K161B, M252 (GE-J1500), Rene 41 (GE-J1610), vanadium, zirconium, molybdenum disilicide, magnesium oxide, and hafnium. The results of chemical analyses of these materials are tabulated. Thermal conductivity was determined by using the radial heat flow method. Specific heat was measured by means of the method of mixtures, and linear thermal expansion was determined by measuring the distance between two recrystallized alumina pins mounted in a rod of the material to be evaluated which was placed in a constant temperature furnace. (P.C.H.)

4552 (AEC-tr-4866) FERROMAGNETISM AND ANTIFERROMAGNETISM OF THE RARE EARTHS. J. Chevalier and W. Baltensperger (Zurich. Eidgenössische Technische Hochschule). Translated from French. 1961. 7p.

Presented at "Reunion de la Société Suisse de physique, Rolle, Switzerland, May 5-6, 1961."

Some magnetic properties of rare earth metals are discussed using the s-f-exchange model. The theory predicts the antiferromagnetism of Ce, Pr, and Nd. The variation of the Curie or Néel points from one element to another is in good agreement with observed values. The resistivities due to magnetic scattering depend on the spin only of the 4f shell. A model is set up to clarify the role of spin-orbit coupling in rare earth ions interacting with conduction electrons. (auth)

4553 (AEC-tr-4904) INFLUENCE OF DIFFUSION DURING SOLIDIFICATION ON THE PROPORTION OF EUTECTIC IN BINARY ALLOYS. Michel Drouzy and Claude Mascré. Translated by Herbert Fischer and Susan Fischer (Los Alamos Scientific Lab., N. Mex.) from Mém. sci. rev. mét., 58: 241-60(Apr. 1961). 48p.

Presented at the Fall Metallurgical Meetings of the Societe francaise de Metallurgie, Paris, October 1960.

The behavior of solidifying alloys was studied. Non-diffusion in the solid, partial diffusion in the solid, and partial diffusion in the liquid were considered. Cooling curves were plotted for Al–Cu alloys both with and without 0.25% Ti. By producing solidification nuclei, Ti modified the solidification mechanism of the solid solution. The proportions of eutectic distributions of the elements in solution, diffusion in the solid, diffusion in the liquid, and grain size were determined. (M.C.G.)

4554 (FTD-TT-61-58) A HIGH-VACUUM, HIGH-TEMPERATURE, SOLID LUBRICANT. L. N. Sentyurikhina, B. N. Malyshev, E. (Ye.) M. Oparina, and Z. S. Rubtsova. Translated from Khim. i Tekhnol. Topliv i Masel, 6: No. 7, 13-15(1961). 6p.

Use of MoS_2 as a solid lubricant is discussed. It is shown that the decomposition temperature of MoS_2 is a function of the degree of rarefaction. The adhesion of molybdenum disulfide to the friction surface was increased using resins as vehicles. The solid lubricating coating in the form of a suspension was applied to parts with a sprayer, allowing smooth, even films to be obtained. Factors influencing the drying of the solid lubricating coating and the speed of formation of the film are outlined. To obtain a solid lubricant, the parts with films applied to them were subjected to vacuum annealing. (M.C.G.)

4555 (FTD-TT-61-74) THE REACTION OF CERTAIN OXIDES AND CARBIDES WITH REFRACTORY METALS AT HIGH TEMPERATURES. G. V. Samsonov, G. A. Yasinskaya, and E. A. Shiller. Translated from Ogneupory, No. 7, 335-8(1961). 7p.

The results of an investigation of the contact reaction of BeO, MgO, ZrO_2, and metal carbides (Zr, Hf, Nb, and Ta) with Nb, Mo, and W at temperatures up to 2100° are given. Tungsten was found to possess the greatest stability in contact with BeO, molybdenum and tungsten with MgO, and molybdenum with stabilized zirconium oxide. Tantalum carbide is most stable in contact with molybdenum up to 2100°; the reaction of molybdenum with zirconium carbide, hafnium carbide, and niobium carbide begins at 1800 to 2000°. (P.C.H.)

4556 (NP-tr-828) EFFECT OF HEAT TREATMENT IN THE GAMMA PHASE ON THE APPEARANCE OF SUBSTRUCTURES IN URANIUM AND IN LOW-CONTENT U–Cr ALLOYS. A. Robillard, D. Calais, and P. Lacombe. Translated by P. E. Child (U.K.A.E.A. Atomic Energy Re-

search Establishment, Harwell, Berks, Eng.) from Rev. mét., 55: 815-28(1958). 36p. (Handwritten MS. Copy).

In a study of the recrystallization of U, a sub-structure superimposed on the α structure was found to form after heat treatment in the γ phase. Conditions for the appearance of the sub-structure were studied for U and U−1.4 at.% Cr alloys. It is believed that the sub-structure represents the polygonization of the β phase after the $\gamma \rightarrow \beta$ transformation, and the role of impurities in the sub-structure formation is discussed. (D.L.C.)

4557 (SCL-T-391) ON THE PLASTIC DEFORMATION OF POLYCRYSTALS. E. Kroener. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Acta Met., 9: No. 2, 155-61(Feb. 1961). 15p.

The problem of polycrystalline plasticity is given a formulation which is mathematically and physically correct. First a typical single crystal problem (which is essentially atomistic) has to be solved, while the second step implies a problem of elasticity theory applied to the continuum mechanics of a polycrystalline medium. This can be solved rather generally to a high degree of approximation and yields the effective stress existing in the individual grains as dependent on previous treatment, external stress, and orientation. The effective stresses determine which glide systems are operated. With the aid of these calculations the polycrystalline stress-strain curve can be derived from single crystal curves. (auth)

4558 SEPARATION OF THE STRUCTURAL CONSTITUENTS OF THE Cr−Mn−N AUSTENITIC STEELS. Hanuš Tuma and Karel Loebe. Acad. rep. populare Romîne, Studii cercetări met., 6: 151-60(1961). (In Romanian)

The separation of the constituents of Cr−Mn−N austenitic steels is not possible electrolytically because the isolated product contains large quantities of mixed crystals. For this reason a method based on the high solubility of these steels in sulfuric acid is recommended. In this method a weighed sample of the material is exposed to 1:4 sulfuric acid heated to 40°C for ten minutes. At the end of this time the sample is removed from the solution and the isolated part is separated by centrifugation, washed with water, alcohol, and ether, and dried at 50°C in vacuum. Considering that sulfuric acid is a very active agent, the losses of isolated product do not exceed 2%. This method is not applicable to iron carbide, nor in the presence of vanadium. The structural stability of a Cr−Mn−N austenitic steel could be determined using this method. If the steel is exposed to temperatures of 650, 700, and 800°C for a long period, the separation of the complex chromium carbide ($M_{23}C_6$) (M being Cr, Fe, or Mo) could be established during the first phase. After a prolonged anneal (more than 300 hr at 650°C and less than 50 hr at 800°C), chromium nitride is separated. This separation is still incomplete after 5000 hr of anneal. The mechanical properties and the corrosion resistance decrease sharply with the separation of the chromium nitride. (tr-auth)

4559 STUDY OF THE COHERENCE BETWEEN SOME CALORIMETRIC DATA AND CERTAIN ELEMENTS OF THE Al−Zn PHASE DIAGRAM. Françoise Frignet and Raoul Hagège. Compt. rend., 253: 1938-40(Oct. 30, 1961). (In French)

Studies were made on the Al−Zn phase diagrams in order to calculate the enthalpy of mixture, total or partial, of solutions which correspond to certain points on the diagram. (P.C.H.)

4560 THERMAL CONDUCTIVITY OF UO_2 AT LOW TEMPERATURE. Olivier Béthoux, Pierre Thomas, and Louis Weil (Centre National de la Recherche Scientifique, Paris; Université, Grenoble, France; and Centre d'Etudes Nucleaires, Grenoble, France). Compt. rend., 253: 2043-5(Nov. 6, 1961). (In French)

The low values of the thermal conductivity of UO_2 at low temperatures are due, at 10 to 300°K, to the diffusion of the phonons by the magnetic moments of the U^{4+} ions. This diffusion limits the mean free path of the phonons to 40 Å at 30 to 300°K. (tr-auth)

4561 TWINNING OF BERYLLIUM AT HIGH TEMPERATURE AND RECRYSTALLIZATION AFTER TWINNING WITH THE AID OF AN OPTICAL METHOD OF DETERMINATION OF THE SENARY AXIS AND BY X RADIATIONS. Pierre Pointu, Pierre Azou, and Paul Bastien (Centre de Recherches de Physique des Metaux de l'Ecole Centrale des Arts et Manufactures, [France]). Compt. rend., 253: 2084-6(Nov. 6, 1961). (In French)

A description is given of the twinning $(10\bar{1}2)$ after rolling at 1000 and 1070°C. A grain by grain study of x radiation, after annealing for 2 hours and 30 minutes at 1000°C, shows that the remaining grains are of two kinds: those in which the orientation is similar to the orientation of the twin crystal and those which are essentially deducted from the matrix by a 30° rotation around the axis. Discussion is also given on the optic determination of the axis. (P.C.H.)

4562 PROPERTIES OF PYROLYTIC GRAPHITE. J. Pappis and S. L. Blum (Raytheon Co., Waltham, Mass.). J. Am. Ceram. Soc., 44: 592-7(Dec. 1961).

The structure, properties, and possible uses of pyrolytic graphite are presented, discussed, and compared with the properties of other high-temperature materials. Since pyrolytic graphite is highly oriented, thermal, mechanical, and electrical properties are anisotropic. Parallel to the basal planes, the material is a thermal and electrical conductor and extremely strong mechanically. Perpendicular to the basal planes, the material is a thermal and electrical insulator and mechanically weak. Graphitizing the material increases the preferred orientation and thus accentuates the anisotropy in the aforementioned properties. As a function of the testing temperature, pyrolytic graphite becomes mechanically stronger along the basal planes. Thermally, perpendicular to the basal planes, the material continues to exhibit excellent thermal insulation. (P.C.H.)

4563 NOTE ON THE SYSTEM NIOBIUM OXIDE−ZINC OXIDE. A. J. Pollard (Naval Research Lab., Washington, D. C.). J. Am. Ceram. Soc., 44: 630(Dec. 1961).

Melting point determinations and x-ray diffraction techniques were used to study the Nb_2O_5−ZnO system. Two compounds which melted congruently were found, and there was evidence for the existence of solid solutions in both end memebers of the system. The compound $3ZnO-Nb_2O_5$ melted at 1308°C, and $ZnO-Nb_2O_5$ melted at 1400°C. The three eutectics were at 20, 32, and 60 mole% Nb_2O_5 and melted at 1300, 1285, and 1365°C, respectively. Melting point and x-ray data were in agreement. Both crystals melted sharply at the temperatures indicated and recrystallized from the melt, even on being cooled rapidly, as large needlelike crystals. Small shifts in the characteristic powder diagrams of zinc oxide containing small percentages of niobium oxide, and of niobium oxide containing small percentages of zinc oxide, indicated some solid solubility. Neither of the zinc−niobium mixed oxides showed such an effect under the same conditions. (P.C.H.)

4564 INTERPRETATION OF THE SYSTEM UO_2−ZrO_2. P. E. Evans (Univ. of Manchester, Eng.). J. Am. Ceram. Soc., 44: 631(Dec. 1961).

A summary of previous works on the UO_2-ZrO_2 system is given. Discussion is given on equilibrium, transformation kinetics, and thermal etching of the system at various mole percents. Special mention is made of the ZrO-rich system. (P.C.H.)

4565 DENSITY OF LIQUID URANIUM. A. V. Grosse, J. A. Cahill, and A. K. Kirshenbaum (Temple Univ., Philadelphia). J. Am. Chem. Soc., 83: 4665-6(Nov. 20, 1961).

The density of pure liquid U was determined by the Archimedean method, from its melting point (1406°K) to about 1900°K. The equation of the density of liquid uranium, determined by the method of least squares, is D_{liq} in g/cm^3 = $19.356-10.328 \times 10^{-4}$ T, with a probable error of ±0.078%. It was concluded that liquid density is a straight line function of temperature far beyond the metal's normal boiling point, because the saturated vapor density of metal, which according to the law of rectilinear diameter causes deviation from linearity, assumes significant values only substantially above the normal boiling point. From the data tabulated, liquid densities of pure U^{235}, U^{233}, and U^{238} can be calculated. (P.C.H.)

4566 THE SURFACE ENERGY OF SOLID NIOBIUM. S. V. Radcliffe (Manufacturing Labs. Inc., Cambridge, Mass.). J. Less-Common Metals, 3: 360-6(Oct. 1961). (In English)

The surface energy of solid niobium was measured by a modification of the wire method utilizing an electron-bombardment heating technique. At 2250°C the surface energy is 2100 ergs cm^{-2}. This result is consistent with a theoretical estimate. From measurements of the dihedral angle of grain boundary grooves formed by thermal etching, the grain boundary interfacial energy of niobium is computed to be 0.36 of the surface energy. (auth)

4567 SELECTIVE DECORATION OF FINE STRUCTURAL EFFECTS IN BERYLLIUM. H. M. Lindsay, V. D. Scott, and A. Moore (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Less-Common Metals, 3: 407-11(Oct, 1961). (In English)

A new chemical method to reveal submicroscopic structural effects in beryllium, such as iron-rich precipitates developed during aging, was developed. The method involves an ion-exchange reaction in which copper decorates localized regions in the metal and it is simply carried out by immersing the metallographic surface in an orthophosphoric acid solution containing dissolved copper. The metallographic features were correlated using optical microscopy, electron microscopy, and electron probe microanalysis. Some indication of the wider application to other metal systems is given. (auth)

4568 THE SYSTEM $ZrAl_2-UAl_2$. Guenter Petzow, Siegfried Steeb, and Irmgard Ellinghaus (Max-Planck-Institut für Metallforschung, Stuttgart). J. Nuclear Materials, 4: 316-21(Aug.-Sept. 1961). (In German)

The form of the pseudo-binary system $ZrAl_2-UAl_2$ was established by means of micrography, thermal analysis, and x-ray diffraction. A simple eutectic system was found, with a eutectic point at ≈10 at. % U and 1440 ± 10°C. $ZrAl_2$ cannot take up any uranium into solid solution, but UAl_2 can dissolve up to 22.5 at. % Zr. This contracts the unit cell of UAl_2 from 7.7475 kX to 7.575 kX. (auth)

4569 PHASE DIAGRAMS OF URANIUM MONOCARBIDE-TRANSITION METAL SYSTEMS. J. Barta, G. Briggs, and J. White (Univ. of Sheffield, Eng.). J. Nuclear Materials, 4: 322-4(Aug.-Sept. 1961). (In English)

Phase diagrams were determined for the UC–Cr, UC–Fe, UC–Ni, and UC–UFe_2 systems. No evidence of solid solubility was found in the UC–Cr, UC–Fe, and the UC–UFe_2 systems and these are of the simple binary eutectic type. The UC–Ni system is more complicated and the results obtained indicate the existence of both binary and ternary eutectics. (auth)

4570 RESEARCH ON THE SYSTEM ZIRCONIUM–OXYGEN. I. THE ELECTRICAL RESISTANCE OF OXYGEN-CONTAINING ZIRCONIUM. Erich Gebhardt, Hans-Dieter Seghezzi, and Wolfgang Duerrschnabel (Max-Planck-Institut für Metallforschung, Stuttgart). J. Nuclear Materials, 4: 241-54(Aug.-Sept. 1961). (In German)

The temperature dependence of the resistivity of zirconium–oxygen solid solutions was investigated. Measurements were made on specimens, in the form of wires, which had been loaded with oxygen at a pressure of 1.5×10^{-3} mm of mercury and at temperatures in the range 1600-2030°K. Specimens thus prepared were then investigated between room temperature and 2030°K throughout the stability range of the metallic solid solution (0 to about 30 at. % oxygen). It was found that the resistivity of the oxygen-bearing β zirconium phase has a normal temperature dependence and that Matthiesen's Rule is obeyed by this phase. On the other hand, the more highly oxygenated α zirconium solid solution showed an unexpected temperature dependence of resistivity, and Matthiesen's Rule was not obeyed. It was found that dissolved oxygen reduces the slope of the resistivity-temperature curves and that a negative temperature coefficient arises above a definite critical temperature. This critical temperature is a function of oxygen content; for α zirconium containing, for instance, 18 at. % oxygen it is about 550°K. (auth)

4571 RESEARCH ON THE SYSTEM ZIRCONIUM–OXYGEN. II. RESEARCH ON THE KINETICS OF THE REACTION BETWEEN ZIRCONIUM AND OXYGEN AND ALSO THE CONSTITUTION OF THE SYSTEM ZIRCONIUM–OXYGEN. Erich Gebhardt, Hans-Dieter Seghezzi, and Wolfgang Duerrschnabel (Max-Planck-Institut für Metallforschung, Stuttgart). J. Nuclear Materials, 4: 255-68 (Aug.-Sept. 1961). (In German)

The constitution of the $Zr-ZrO_2$ system was established by means of metallographic investigation and resistivity measurements. Wires of reactor grade zirconium were isothermally and isobarically loaded with oxygen at a pressure of 1.5×10^{-3} mm of mercury and at temperatures in the range 1600-2030°K. Under these conditions, a uniform oxygen concentration existed throughout the wire cross section at all stages of oxygen loading. According to the present investigation, the phase diagram differs in some particulars from earlier diagrams. These deviations refer to the solubility of oxygen in α zirconium, the delineation of the two phase region between α and β zirconium, and the solubility of Zr in ZrO_2. The form of the solubility limit of Zr in ZrO_2 suggests the existence of a high temperature form of ZrO_2 stable above 1850°K. This high temperature form could not be retained by quenching and was therefore not investigated further. A knowledge of the total emissivity and the resistivity of the oxide was of importance for adjusting the temperature of the specimens. Approximate values of these quantities were determined. (auth)

4572 RESEARCH ON THE SYSTEM ZIRCONIUM–OXYGEN. III. RECRYSTALLIZATION BEHAVIOR OF ZIRCONIUM WIRES. Erich Gebhardt, Hans-Dieter Seghezzi, and Wolfgang Duerrschnabel (Max-Planck-Institut für Metallforschung, Stuttgart). J. Nuclear Materials, 4: 269-71(Aug.-Sept. 1961). (In German)

The influence of a high vacuum anneal at 1930°K on the electrical resistance at room temperature and on the recrystallization texture was determined. It was found that the resistance reaches a constant end value with increasing annealing time, and that in the α phase a double fiber texture arises with the hexagonal directions [1 1 0] and [1 0 1] as fiber axes. (auth)

4573 THE MORPHOLOGY OF SURFACE REACTION PRODUCTS ON ALUMINUM. R. K. Hart and W. E. Ruther (Argonne National Lab., Ill.). J. Nuclear Materials, 4: 272-80(Aug.-Sept. 1961). (ANL-FGF-244) (In English)

Investigations on the film growth on aluminum and aluminum–1% nickel alloys, limited to films produced by heating in vacuo and dry air at 350 and 540°C, in water vapor at 350°C, in superheated steam at 540°C and 600 psi, and by anodic oxidation in ammonium tartrate, are described. The oxide growths were viewed electron optically in silhouette and were found to take on various shapes such as chunky outcrops, platelets, and whiskers. These outcrops nearly always consisted of well crystallized material, often single crystals, which was in contrast to the structure of the general surface films. Besides finding amorphous and gamma alumina (γ-Al_2O_3) films, a lambda phase (orthorhombic, pseudotetragonal, a = b = 7.63 Å, c = 2.89 Å) was found on the Al–Ni alloy at 540°C in vacuo and a θ-phase (monoclinic, a = 5.7 Å, b = 2.92 Å, c = 11.9 Å) on both aluminum and the Al–Ni alloy when heated in dry air at 350 and also 540°C. Reaction of these materials with steam led to the formation of both corundum (α-Al_2O_3) and gamma alumina. (auth)

4574 THE STRUCTURE AND HEAT TREATMENT OF SOME THORIUM–ZIRCONIUM ALLOYS. R. H. Johnson and R. W. K. Honeycombe (Univ. of Sheffield, Eng.). J. Nuclear Materials, 4: 295-310(Aug.-Sept. 1961). (In English)

The solid solution hardening of α-thorium by zirconium was demonstrated, but the increase in hardness during the ageing of the supersaturated α solid solution is very slight. Microscopic observations indicate that discontinuous precipitation usually occurred. The most promising alloys investigated are those of compositions corresponding to the thorium-rich end of the β solid solution, which exists above 1000°C, after subjection to heat treatment. The β solid solution transformed on quenching; tempering the quenched alloys produced a more stable structure with very useful mechanical properties. A study of the isothermal transformation of the β solid solution was also carried out and a time-temperature-transformation relationship obtained for a 39 at. % zirconium alloy. The transformation product is mainly lamellar and is shown to hold promise of high tensile strength. (auth)

4575 ADIABATIC ELASTIC MODULI OF SINGLE CRYSTAL ALPHA ZIRCONIUM. E. S. Fisher and C. J. Renken (Argonne National Lab., Ill.). J. Nuclear Materials, 4: 311-15(Aug.-Sept. 1961). (ANL-FGF-236) (In English)

The elastic moduli of alpha zirconium at 20°C were derived from measurement of the velocities of ultrasonic waves using the phase comparison technique of McSkimin. The values computed for a density of 6.505 g/cm^3 are as follows in units of 10^{12} dynes/cm^2: $c_{11} = 1.435 \pm 0.002$, $c_{12} = 0.725 \pm 0.002$, $c_{13} = 0.654 \pm 0.002$, $c_{33} = 1.649 \pm 0.002$, and $c_{44} = 0.3207 \pm 0.0003$. (auth)

4576 RETENTION OF α-PHASE NUCLEI IN β-PHASE WEAKLY ALLOYED URANIUM. J. Beaudier, G. Donze, and G. Cabane (Centre d'Études Nucléaires, Saclay, France). J. Nuclear Materials, 4: 325-8(Aug.-Sept. 1961). (In French)

The effect of small additions of Cr, Mn, or Mo on the retention of nuclei of the α-phase in β-uranium was investigated. The kinetics of $\beta \rightarrow \alpha$ transformation show that the size and energy of the retained nuclei are greater than those of the nuclei of spontaneous nucleation. It cannot be concluded from this observation that the $\alpha \rightleftharpoons \beta$ transformation of uranium is of martensitic nature. The observed memory effect has a completely different character. (auth)

4577 THE METALLURGY OF BERYLLIUM. Nuclear Eng., 6: 531-3(Dec. 1961).

The main findings and conclusions described in each session of an International Conference on the Metallurgy of Beryllium held in London, October 16 to 18, 1961, are summarized. Some 70 papers were presented under four main headings: mechanical and physical properties, beryllium in reactors, beryllium in aircraft, and metal preparation and fabrication. (N.W.R.)

4578 DIFFUSION OF COBALT AND SILVER IN ORDERED AND DISORDERED CuZn. C. Bassani, P. Camagni, and S. Pace (C.N.R.N., Ispra, Italy). Nuovo cimento (10), 19: 393-5(Jan. 16, 1961). (CNI-98) (In English)

The diffusion of Co and Ag in β-brass (47.2 at. % Zn) at 320 to 700°C is reported. The temperature dependence of D_{Co} and D_{Ag} was determined in the disordered as well as in the ordered phase of the alloy. On the quantitative side, remarkable differences were found between the behavior of impurities and self-diffusion, especially for Co. The values of U for the various diffusing elements also deviate, in general, from the value of the ordering energy. However, the order of magnitude is respected. Data are tabulated. (P.C.H.)

4579 SOME PHYSICAL PROPERTIES OF THE γ AND δ PHASES IN THE U–Zr SYSTEM. R. D. Barnard (Univ. of Nottingham, Eng.). Proc. Phys. Soc. (London), 78: 722-7 (Nov. 1, 1961).

Electrical resistivity and magnetic susceptibility measurements are reported for U–70 and 74 at. % Zr in both the γ and δ phases. Negative temperature coefficients of resistivity were found in the metastable γ phase of U–70 at. % Zr, and also in the δ phase of both alloys between 90 and 870°K. The Pauli weak spin paramagnetism, exhibited by both specimens, always increased with temperature. The results support the view that the δ phase is primitive hexagonal and not an ordered form of the body-centered cubic γ phase. The anomalous resistivity behavior may be a consequence of the band structure of the alloy. (auth)

4580 HALL EFFECT IN PLUTONIUM. R. G. Loasby and J. C. Taylor (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 78: 776-7(Nov. 1, 1961).

The Hall effect was measured in specimens of α-plutonium (maximum impurities 1000 ppm) and δ-plutonium (stabilized at room temperature by the addition of 3.4 at. % Al) at 77 and 293°K. Preliminary measurements on samples of silver, uranium, and thorium gave results in good agreement with published data, and additionally a value for thorium at 77°K of $-9.8 \pm 0.6 \times 10^{-11}$ m^3 c^{-1} was obtained. All three α-plutonium samples showed a continuous increase in R_H (up to $-18.0 \pm 1.2 \times 10^{-11}$ m^3 c^{-1}) if held at 77°K for up to six hours. After warming to room temperature and remaining there for twelve hours or more, the tabulated values were invariably obtained both at 293°K and initially at 77°K. No time dependent effect was observed in δ-plutonium. (P.C.H.)

4581 THERMOCHEMISTRY OF ALLOYS. A. Schneider, H. Klotz, J. Stendel, and G. Strauss. Pure and Appl. Chem., 2: 13-16(1961).

Measurements are made of enthalpy of formation of InSb, $MgZn_2$, Mg_2Zn_{11} and MgZn; and of enthalpy, free enthalpy, and entropy of formation of Fe_2Zr, Al_4Zr_3, Al_3Zr and Al_2Zr. Calorimetric methods are used, including the drop method and ignition by Fe-S mixture. (auth)

4582 ELECTRICAL PROPERTIES OF Mg_2Si SINGLE CRYSTALS. M. W. Heller and G. C. Danielson (Ames Lab., Ames, Iowa). p.881-4 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960." (IS-164)

The Seebeck coefficients (thermoelectric power) for both n-type and p-type Mg_2Si single crystals were measured from 7 to 1000°K. At low temperatures the magnitude of the Seebeck coefficient showed a pronounced maximum which is interpreted in terms of the phonon drag effect. At high temperatures (intrinsic range) the Seebeck coefficient varied inversely as the absolute temperature. New electrical resistivity and Hall coefficient data were also obtained. (auth)

4583 ZIRCONIUM ALLOYS. Thomas Raine and James Alan Robinson (to Associated Electrical Industries Ltd.). British Patent 884,682. Dec. 13, 1961.

A Zr alloy which has enhanced corrosion resistance to CO_2 at high temperatures consists of 0.5 to 1.5 wt % Cu, 0.25 to 1.5 wt % W, and balance Zr and impurities. Data are tabulated for the weight gain of this alloy in CO_2 at 700°C as compared to other Zr alloys. (D.L.C.)

Radiation Effects

4584 (ANL-6344) EFFECTS OF ROLLING AND HEAT TREATMENT ON ANISOTROPIC IRRADIATION GROWTH OF URANIUM. Final Report—Metallurgy Program 6.1.15. J. H. Kittel (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 31p.

An investigation was made to determine the effect of rolling temperature, roll pass design, amount of reduction, and heat treatment before and after rolling on the anisotropic growth rate of uranium under irradiation. The growth rate was found to increase with decreasing rolling temperature and with increasing reduction of area at 300°C. The rate of elongation was proportional to the amount of (010) component present or, where shortening occurred, to the amount of (100) component. Oval-edge-oval roll passes resulted in somewhat higher irradiation growth rates than did round roll passes. Recrystallization after rolling effectively reduced the irradiation growth rate of uranium rolled at temperatures of 500°C and lower. Irradiation caused length shortening in uranium which was beta quenched after being round-rolled at temperatures of 400°C and above, and which was beta quenched after being oval-rolled at temperatures of 300°C and above. (auth)

4585 (DP-581) MECHANICAL PROPERTIES OF IRRADIATED PLAIN CARBON AND ALLOY STEELS. A Compilation of the Data in the Literature. Richard E. Schreiber, comp. (Du Pont de Nemours (E. I.) and Co. Savannah River Lab., Aiken, S. C.). Oct. 1961. Contract AT(07-2)-1. 82p.

Changes in the mechanical properties of plain carbon and alloy steels that are caused by fast neutron irradiation are presented in graphic form. These data were abstracted from classified and unclassified reports published since 1948 by USAEC, AECL, and AERE. Data are included for the following steels: A-105-55T, A-106, A-200-55T-T22 (Croloy), A-201, A-242, A-301-B, A-302-B, AISI-C-1013, AISI-C-1065, SA-70, SA-193,4, SA-212, SA-285, SA-336, SAE-1018, SAE-1020, SAE-1042, SAE-1045, SAE-1095, SAE-1113, SAE-1141, SAE-4130, and SAE-4340. The mechanical properties for which data are reported include hardness, yield strength, tensile strength, total and uniform elongation, reduction of area, fatigue strength, notch factor, creep, impact energy, and transition temperature. (auth)

4586 (GEMP-6A) HIGH TEMPERATURE MATERIALS PROGRAM. Progress Report No. 6, Part A, September 15—November 15, 1961. (General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Dec. 15, 1961. Contract AT(40-1)-2847. 16p.

A summary is presented of the developments in the radiation effects study of a composition series of BeO, with and without additions of MgO and ZrO_2. (B.O.G.)

4587 (IDO-16729) DAMAGE TO STAINLESS STEEL FUEL IN SPERT REACTORS. R. E. Heffner (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 22, 1961. Contract AT(10-1)-205. 25p.

Limited damage to plate-type fuel assemblies with stainless steel cladding and stainless steel highly enriched UO_2 fuel matrix was observed in three nuclear reactor cores at Spert. Although it was not possible to identify the mechanisms causing the damage, the extent of the correlation of damage and the associated operational conditions should be of interest in considering the use of stainless steel fuel assemblies in power reactors. It must be noted that these observed damage effects, which are blistering and rippling, occurred during power excursion tests. The apparent cause of the rippling is the high temperature differential occurring between the surface of the cladding and the fuel matrix. This temperature differential is enhanced by the relatively poor thermal conductivity of stainless steel. The cause of blister formation is, at present, indeterminate although there appears to be some correlation between fuel segregation (stringers) at the fuel-clad interface and the formation of blisters in the high temperature-high flux region of the fuel plates. Until a more comprehensive understanding of the mechanisms of rippling and blistering of stainless steel fuel plates is obtained, it must be assumed that rippling may be expected during power excursions with initial reactor periods less than 20 msec. A reactor accident of sufficient magnitude to produce conditions equivalent to the tests performed at Spert may be expected to produce fuel damage of the type observed. (auth)

4588 (NP-10802) APPLICATION DES MESURES MAGNETIQUES A L'ETUDE DES EFFECTS D'IRRADIATION. (Application of Magnetic Measurements to the Study of Effects of Irradiation). D. Dautreppe, J. Pauleve, P. Moser, and P. Brissonneau (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). [nd.] 10p.

Two magnetic phenomena which can be used in the study of irradiation effects are (1) magnetic coupling hysteresis of diffusion and (2) orientation superstructure. Neutron-irradiated iron exhibits a coupling hysteresis band, the site of the band depending on the neutron dose. A polycrystalline alloy of Fe—Ni was irradiated in the Melusine in the presence of a 2500 oersted field. The anisotropy energies vary as a function of the neutron energy. After irradiation the anisotropy continues to evolve even at room temperature. The results obtained are shown graphically. (J.S.R.)

4589 (NP-11146) DIP COAT PACKAGING OF IRRADIATED FOODS. Report No. 12(Final), May 15, 1958—

November 14, 1960. L. J. Bratzler (Michigan State Univ., East Lansing). Contract DA19-129-QM-1195. 6p.

Thirteen materials, two ethyl cellulose formulations, one emulsifiable polyethylene, and ten petroleum waxes, were studied as possible materials for dip coating meat products. As a result of blocking, impact, and water vapor transmission tests, three materials were used to dip coat pork roasts and chickens: Dow Ethocel X2203.10, Wasco WA/39-94, and Kalamazoo Paraffin formulation KP4. The Dow material was considered to be the best as it did not oil off as much as the Wasco Pak, whereas the petroleum wax did not withstand impact or blocking tests. The polyethylene was too brittle and also contained toxic materials. When used as dip coatings for pork roasts and chickens and for cooked pork roasts and cooked game hens, all three materials provided adequate protection from weight loss when stored at 0°F for one year. Panel evaluations for acceptability and chemical analyses for TBA revealed no consistent trends. Cooked pork roasts and game hens irradiated at six megarads were scored significantly lower than the unirradiated items. The materials did not provide adequate protection to cooked, irradiated pork roasts and game hens for storage at 100°F, 90% R.H. (auth)

4590 (REIC-21) THE EFFECT OF NUCLEAR RADIATION ON ELASTOMERIC AND PLASTIC COMPONENTS AND MATERIALS. R. W. King, N. J. Broadway, and S. Palinchak (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Sept. 1, 1961. Contract AF33(616)-7375. 370p.

The state of the art of the effects of nuclear radiation on elastomeric and plastic components and materials, as developed from 1947 to the present, is presented. The mechanism of radiation damage and the effects of radiation in various environments are briefly discussed. Data summarizing the radiation-effects information on specific components and on the various types of elastomers and plastics are presented in detail. Areas in which additional work is needed are indicated. Radiation polymerization or vulcanization are included only if the data have a bearing on radiation effects on the finished polymer. 205 references are given. (auth)

4591 (USASRDL-TR-2064) NONTRANSIENT NUCLEAR REACTOR EXPERIMENTS ON POWER TRANSISTORS. Frederick Gordon, Jr. (Army Signal Research and Development Lab., Fort Monmouth, N. J.). July 15, 1959. 34p.

The techniques and results of nuclear reactor experiments on power transistors are reported. Two reactor facilities were utilized: the Bulk Shielding Facility at Brookhaven National Laboratory, and the Curtiss-Wright Swimming-Pool Reactor at Quehanna, Pa. The following measurements were made: grounded-emitter current gain (H_{FE}); reverse collector current (I_{CO}); and $V_c - I_c$ curves. In addition special performance tests were made on a d-c-to-d-c converter using lower power transistors. (auth)

4592 EFFECTS OF HIGH ENERGY IONIZING RADIATION ON CRYSTALLINITIES OF CELLULOSE II, III AND IV. Hiroshi Sobue and Yoshitami Saito (Tokyo Univ.). Bull. Chem. Soc. Japan, 34: 1343-4(Sept. 1961). (In English)

Viscose rayon was used as cellulose II. Cellulose III was prepared by treatments of the cellulose II in liquid ammonia at about −78°C for four hours, and the ammonia was removed above 0°C. Cellulose IV was made from cellulose II by treatments in glycerin at 260 to 265°C for one hour. The decrease of crystalline regions is not observed for all celluloses by irradiation up to 5×10^7 rad. However, with irradiation of above 5×10^7 rad, remarkable lowering of crystallinities was observed in all types of celluloses. No remarkable differences between x-ray diffractive crystallinities of unirradiated samples and those of samples irradiated with 10^7 to 3×10^8 rad was observed. Thus, the crystallinities of these celluloses are quite different depending on the measuring methods. (P.C.H.)

4593 NEUTRON AND GAMMA IRRADIATION OF SOME SQUARE-LOOP AND MICROWAVE FERRITES. R. W. Moss (Boeing Scientific Research Labs., Seattle), C. F. Kooi, and M. E. Bladwin. Commun. and Electronics, No. 56, 362-7(Sept. 1961).

Damage to several magnetic ferrites by nuclear reactor radiation resulted from irradiation with fast neutrons although the possibility of effects from gamma irradiation at levels about 10^{10} roentgens cannot be ruled out. For fast neutron irradiation of 3×10^{18} cm^{-2}, the saturation magnetization increases in nickel ferrite, while it decreases in yttrium iron garnet. This is a consequence of the different magnetic structure of these two materials. Square-loop and normal-loop ferrites are affected at 10^{18} fast neutrons per cm^2 and a ferrite of the permalloy type, which depends on cation ordering for its magnetic properties, is very strongly affected at 10^{18} fast neutron/cm^2. The switching time is a function of switching field for two manganese-magnesium square-loop ferrites was found to be independent of fast neutron irradiation up to 3×10^{18} cm^{-2}. The microwave line width of polycrystalline yttrium iron garnet was decreased slightly at 3×10^{18} fast neutrons per cm^2. (P.C.H.)

4594 CONTRIBUTION OF MEASUREMENTS OF THE SPECIFIC HEAT OF IRRADIATED BERYLLIUM OXIDE TO THE STUDY OF THE COALESCENCE OF HELIUM. Jean Aslanian, Roger Caillat, Marc Salesse, and Louis Weil (Centre National de la Recherche Scientifique, [Paris]; Université, Grenoble, France; and Centre d'Etudes Nucleaires, Saclay, France). Compt. rend., 253: 1032-3 (Aug. 21, 1961). (In French)

During anneal of neutron-irradiated BeO, the helium was collected. The λ point of helium appeared and the specific heat increased. (tr-auth)

4595 ATTEMPT AT THE INTERPRETATION OF THE EFFECT OF PRESSURE ON THE SHEAR MODULUS OF TWO GLASSES IRRADIATED WITH NEUTRONS. Jean Paymal and Christiane Susse (Centre de Recherches de la Compagnie, Saint-Gobain, France and Centre National de la Recherche Scientifique, Paris). Compt. rend., 253: 1196-8(Sept. 11, 1961). (In French)

The anomaly of the negative β values (coefficient of pressure) for a neutron-irradiated boron glass and a lead glass is discussed in an attempt at interpretation. The rapid increase of β in pyrex as a function of the dose at doses less than 0.1×10^{18} n/cm^2 appears to be ascribable to hot zones. In the lead glass the variations of β reflect destruction of certain bonds and appearance of cations in metastable positions, replacement of cations, and modification of the general configuration. (J.S.R.)

4596 THE MECHANICAL PROPERTIES OF SOME HIGHLY IRRADIATED BERYLLIUM. J. B. Rich, G. P. Walters, and R. S. Barnes (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 287-94(Aug.-Sept. 1961). (AERE-R-3449) (In English)

Hot-pressed beryllium was examined after irradiation with more than 10^{21} fast neutrons/cm^2 while at a temperature which varied between 280 and 480°C. The smaller helium content (3.7 cm^3 at NTP/cm^3 Be), produced much

smaller volume increases. The volume did not measurably increase during irradiation but did so only after heating for one hour at above 800°C. A small number of tensile samples were cut from the material and pulled at room temperature, 300, 450, and 600°C. The 0.1% proof stress and ultimate tensile stress increased by a factor of more than 2, and the elongation reduced to practically zero at all these temperatures. Some recovery of the mechanical properties was achieved by annealing at temperatures above 800°C. The results are described in terms of the distribution of the helium bubbles which were observed in replicas and thin films from the material. (auth)

4597 ELECTRON MICROSCOPE OBSERVATIONS OF FAST NEUTRON DAMAGE IN GOLD FILMS. A. Grenall (Atomics International, Canoga Park, Calif.). J. Nuclear Materials, 4: 329-31(Aug.-Sept. 1961). (In English)

A continuous gold film, vacuum deposited on a carbon substrate previously laid down on a collodion film on standard specimen screens, was irradiated with 9.7×10^{11} neutrons per cm^2 per sec. Study of the photographs before and after showed that the outstanding difference was the appearance on the pictures of the 4.5 day irradiation sample of black spots distributed quite randomly in the gold particles, giving rise to a measles effect. There was little or no evidence for such spots on the photographs of the samples after the 4.5 minute irradiation and none of all in the initial state. The observed concentrations of spots were $(3.3 \pm 1.0) \times 10^{16}$ per cm^3 and $(2.8 \pm 1.3) \times 10^{16}$ per cm^3. The average diameter of these black spots was 65 ± 7 Å. (P.C.H.)

4598 AN INTERPRETATION OF ELECTRON MICROSCOPE OBSERVATIONS IN NEUTRON-IRRADIATED COPPER AND GOLD. J. A. Brinkman, A. Sosin, and A. Grenall (Atomics International, Canoga Park, Calif.). J. Nuclear Materials, 4: 332-3(Aug.-Sept. 1961). (In English)

The differences in the characteristics of spots observed to date in copper and gold after neutron irradiation are discussed. The main conclusions are: in gold there is a good correlation between concentration of spots, number of primary collisions, and the integrated neutron flux; in copper the concentration of spots increases with flux less rapidly than a first power relationship. In gold the spot size remains sensibly constant; in copper the size distribution shifts toward large diameters at higher fluxes. Other works are cited that are believed to provide reasonable, direct evidence for the existence of displacement spikes produced by fast neutrons, as well as by fission fragments in heavy metals. (P.C.H.)

4599 THE EFFECT OF IRRADIATION AND POST IRRADIATION ANNEALING ON THE ELECTRICAL RESISTIVITY OF URANIUM MONOCARBIDE. L. B. Griffiths (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Nuclear Materials, 4: 336(Aug.-Sept. 1961). (In English)

Small, square section bars, with a final bulk density 91.8% of that determined by x-ray methods, were irradiated at 70°C. Neutron irradiation resulted in an increase in electrical resistivity. After irradiation the specimen which received the heaviest neutron dose was annealed for one hour periods at various increasing temperatures and its electrical resistivity was measured at the end of each period. It was evident that the damage undergone by the uranium monocarbide lattice during irradiation at about 70°C anneals out in two quite distinct stages, one at 100 to 130°C and the other at 700 to 730°C. (P.C.H.)

4600 RADIATION EFFECTS ON LITHIUM-DOPED NICKEL OXIDE CATALYSTS IN CARBON MONOXIDE OXIDATION. T. Braun and I. Maxim (Inst. for Atomic Physics, Bucharest). Nature, 192: 548-9(Nov. 11, 1961).

Results are shown giving the variations of the reaction rate before and after irradiation. It is shown that doping with lithium enhances the efficiency of nuclear radiations through the reaction $Li(n,\alpha)H^3$. Thus, in the neutron flux the lithium atoms become an important source of internal irradiation. On the other hand, the results of the catalytic oxidation of carbon monoxide yield more reproducible results on NiO + Li_2O than on pure NiO. Hence, the results show that irradiation significantly affects the activation energy of the catalytic oxidation of carbon monoxide and that the effects increase with increasing irradiation time. (N.W.R.)

4601 THE STACKING-FAULT ENERGY OF GRAPHITE. C. Baker, Y. T. Chou, and A. Kelly (Cambridge Univ., Eng.). Phil. Mag. (8), 6: 1305-8(Oct. 1961).

Stacking fault energies are obtained from electron transmission micrographs. The equilibrium separation of the partial dislocations in a long straight extended dislocation is measured, and the solution of the elasticity equations is exact provided the thickness of the foil is much larger than the equilibrium separation of the partial dislocations. This method is applied to graphite, using anisotropic elasticity. Values obtained, represented graphically, differ by more than an order of magnitude from those obtained using isotropic elasticity. All determinations were made on irradiated crystals. (L.N.N.)

PHYSICS

General and Miscellaneous

Refer also to abstract 4371.

4602 (AD-258147) MEASUREMENT OF CHARGE-TRANSFER CROSS SECTIONS. Final Report, May 1, 1959–April 30, 1961. O. Heinz (Stanford Research Inst., Menlo Park, Calif.). May 26, 1961. Contract DA-04-200-ORD-962. 42p.

Progress made on various aspects of research on atomic and molecular charge-transfer processes is reported for: experimental results pertaining to charge-transfer processes reported in the literature between 1950 and 1960 collected and tabulated on IBM punched cards and reproduced directly from the cards in report form; measurements of the relative efficiency of various gases in converting fast, ~3 kev, beams of N^+ and N_2^+ into N and N_2 neutral beams, respectively; measurements of the charge-transfer cross sections for the reactions $N^+ + A \rightarrow N + A^+$, $N_2^+ + A \rightarrow N_2 + A^+$, and $A^+ + A \rightarrow A + A^+$; and a preliminary study of experimental methods for detection of excited, particularly metastable, ions and atoms in beams. (auth)

4603 (AFSWC-TR-61-72(Vol.I)) RADIATIVE PROPERTIES OF HIGH TEMPERATURE GASES. B. H. Armstrong, D. E. Buttrey, L. Sartori, A. J. F. Siegert, and J. D. Weisner (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Oct. 1961. Contract AF29(601)-2774. 219p.

A theory is presented and discussed which is intended to establish a rigorous basis for the computation of the number of ions in given quantum states, for a partially ionized gas in thermal equilibrium, in the low density limit. A calculation of the line contribution to the Planck mean absorption coefficient is made for nitrogen and oxygen and a measure of its significance to the Rosseland mean absorption coefficient is derived. Line broadening theories are discussed with respect to the calculation of absorption coefficients. A tabulation is presented of Debye lengths, ion sphere radii, occupation numbers, and other parameters of significance to the radiative properties of nitrogen and oxygen. Measurements have been made of absolute intensity of the radiation from shock heated nitrogen and oxygen in the temperature range of 8000 to 18,000°K. The wavelength range investigated is from 3500 to 5600 A. Transition probabilities for the N_2^+ First Negative System have been inferred from the measurements. Preliminary measurements of continuum intensities for oxygen at 18,000°K yield important information on shifts in photoelectric edges, profiles of Stark-broadened O-I lines, and on the effective reduction in the ionization potential due to plasma effects. Trace quantities of hydrogen were introduced into each gas and the time-resolved Balmer line profiles were used as a measure of the ion density in the reflected shock. (auth)

4604 (ANU/P-235) THE FUTURE OF NUCLEAR PHYSICS IN AUSTRALIA. E. W. Titterton (Australian National Univ., Canberra. Research School of Physical Sciences). [1961]. 13p.

The status of experimental and theoretical nuclear physics in Australia is reviewed. The programs of high and low energy physics and cosmic ray research in Australian universities are outlined. The basic features of accelerators, detectors, and spectrometers in use and planned are noted, and future prospects for work in nuclear physics in Australia are projected. (T.F.H.)

4605 (AROD-431:43) ELEMENTARY EXCITATIONS IN A SYSTEM OF INTERACTING BOSONS, WITH APPLICATION TO LIQUID HELIUM II. Technical Report No. 27. David Pines (Illinois. Univ., Urbana). Aug. 1961. Contract DA-11-022-ORD-1001. 67p.

Lectures delivered at the summer school on Liquid Helium of the Societa Italiana di Fisica, Varenna, July 1961.

A series of lectures is presented on elementary excitation in a system of interacting bosons, with application to liquid He II. Topics covered are: microscopic theory of He^4, the role of condensed, zero momentum states in the formulation of the theory, and the motion of impurity atoms in liquid He. (auth)

4606 (BNL-682) ANNUAL REPORT [ON PHYSICAL SCIENCES, ENGINEERING AND LIFE SCIENCES], JULY 1, 1961. (Brookhaven National Lab., Upton, N. Y.). Contract [AT(30-2)-Gen-16]. 172p.

The research program at Brookhaven is described. Current activities in physics, high-energy accelerators, instrumentation, chemistry, nuclear engineering, applied mathematics, biology, and medical research are outlined. (D.L.C.)

4607 (NBS-TN-91) DETERMINATION OF THE K FLUORESCENCE YIELD OF ARGON BY PROPORTIONAL-COUNTER SPECTROMETRY. Claire Godeau (National Bureau of Standards, Washington, D. C.). May 1961. 14p. (PB-161592)

A proportional counter spectrometer designed for investigation of low energy particles is used for the determination of the K fluorescence yield of argon. X rays following K capture in Fe^{55} are used as a source for excitation of the argon atom. The K fluorescence yield ω_k is deduced from a comparison of the two peaks shown in the spectrum, and corrections are made to take into account photoelectric absorption in outer shells and reabsorption of secondary x rays in the counter. The value of ω_k is found to be 0.087 ± 0.007 for Ar. (auth)

4608 (NBS-TN-92) RESEARCH PROGRAM OF THE RADIATION PHYSICS DIVISION, NATIONAL BUREAU OF STANDARDS. W. R. Ney and L. S. Taylor (National Bureau of Standards, Washington, D. C.). May 1961. 51p. (PB-161593)

The organizational plan of the division is set forth, together with a brief presentation of the activities carried out in the various sections. A statement of the mission of the division, a list of senior staff members, descriptions of the facilities available to the division staff, and detailed descriptions of the research programs of the various sections of the division are included. Although only programs upon which there has been activity within the past year are covered, in some instances brief mention is made of the direction of future work for which plans have already been made. (P.C.H.)

4609 (NP-10943) CINEMICROSCOPIC STUDIES OF ELECTRICALLY EXPLODED WIRES AND FILMS. Final Report. L. Zernow, G. Woffinden, and F. Wright (Aerojet-General Corp. Ordnance Div., Downey, Calif.). Oct. 5, 1961. (AROD-2036.5). Includes Appendixes: A. THE CINEMICROSCOPIC OBSERVATION OF EXPLODING

WIRES. L. Zernow and G. Woffinden. (AROD-2036.1). B. HIGH SPEED CINEMICROSCOPY OF ELECTRICALLY EXPLODED TUNGSTEN AND MOLYBDENUM WIRES. L. Zernow, G. Woffinden, and K. N. Kreyenhagen. (AROD-2036.2; AD-227017). C. HIGH SPEED PHOTOGRAPHIC STUDIES OF ELECTRICALLY EXPLODED METAL FILMS AND WIRES. L. Zernow, G. Woffinden, and F. Wright, Jr. (AROD-2036.3). D. HIGH SPEED PHOTOGRAPHIC STUDIES OF ELECTRICALLY EXPLODED METAL FILMS AND WIRES. L. Zernow, G. Woffinden, and F. Wright, Jr. (AROD-2036.4). Contract DA-04-495-ORD-1407. 174p.

The fundamental physical processes which occur in the explosion of metal wires and films were studied using cinemicroscopy. It is shown that as the energy input increases, exploding wires go through an unduloid stage and into a striated mode of explosion. It was found that the striations are the result of the interaction of bubble-like structures which develop on the exploding wire. Impurities such as 3% ThO_2 in tungsten wire were found to have drastic effects on the wire behavior, markedly lowering the energy at which breakup occurs and causing the formation of many small bubbles instead of the larger ones which normally cause the striated mode. Exploding films were shown to undergo a two-stage process. First, striations perpendicular to the nominal current path developed. Then, if critical voltage was exceeded, a second process of surface discharge was observed. Current-time measurements agreed fully with the optical observations. The striations were found to have a polarized dendritic structure. (M.C.G.)

4610 (NP-11058) QUARTERLY PROGRESS REPORT NO. 63 [ON ELECTRONICS]. H. J. Zimmermann, G. G. Harvey, and W. B. Davenport, Jr. (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Oct. 15, 1961. Contract DA36-039-sc-78108. 249p.

Progress is reported for studies made in physical electronics, plasma dynamics, solid state physics, microwave spectroscopy, nuclear magnetic resonance, hyperfine structure, microwave electronics, molecular beams, statistical communication theory, processing and transmission of information, physical acoustics, speech communication, linguistics, communications biophysics, neurophysiology, neurology, and computer components and systems. (B.O.G.)

4611 (NP-11098) NRL QUARTERLY ON NUCLEAR SCIENCE AND TECHNOLOGY. Progress Report, July–September. (Naval Research Lab., Washington, D. C.). Oct. 1, 1961. 54p.

Progress is reported for studies in nuclear physics, high-temperature physics, and metallurgy and ceramics. Ten papers are included on: differential cross sections for tritium reactions with nitrogen-14(t,α) and (t,d_0), and carbon-12; Lee Model applications to deuterons; C^{12} $(\gamma,3\alpha)$ reactions below 21.5 Mev; operational behavior of B_4C reactor control rods; slow neutron diffusion; finite geometry angular correlation correction coefficients; underwater radiation monitors; and corrosion of steel in LiOH. Separate abstracts have been prepared for seven of the papers. (B.O.G.)

4612 (NP-11098(p.3-13)) DIFFERENTIAL CROSS SECTIONS FOR TRITIUM-INDUCED REACTIONS ON C^{12}. G. D. Gutsche, H. D. Holmgren, et al. (Naval Research Lab., Washington, D. C.).

Measurements were made on the proton group leading to the ground state of carbon-14, and on the α groups leading to the ground state and first-excited state of boron-11, differential cross sections for elastically scattered tritons as functions of bombarding energy for several angles, and of the angle of emission for triton energies from 0.900 to 2.000 Mev. (B.O.G.)

4613 (NP-11098(p.14-22)) A NOTE ON THE LEE MODEL APPLIED TO THE DEUTERON. W. W. Wada (Naval Research Lab., Washington, D. C.).

Studies were made of the properties of the deuteron state and the low-energy proton and neutron scattering states from the Lee model point of view for a field theory. It was found that the program of the renormalization procedures characteristic to the model can be carried out, and that the condition under which no anomalous states can occur in the deuteron is satisfied when a proper identification of the renormalized parameters of the model with the observed low-energy spin triplet s-orbital proton-neutron scattering parameters is made. (B.O.G.)

4614 (NP-11098(p.23-9)) THE $C^{12}(\gamma,3\alpha)$ REACTION BELOW 21.5 MEV. M. Elaine Toms (Naval Research Lab., Washington, D. C.).

Ilford E.1, 100-micron-thick nuclear emulsions were exposed to 21.5-Mev bremsstrahlung filtered by aluminum to verify the apparent structure of the $C^{12}(\gamma,3\alpha)$ cross section to 21 Mev. An analysis of the results was compared with results obtained for a graphite-filter spectrum. The integrated cross section values to 21 Mev of carbon-12 excitations are 0.97 ± 0.07 for the aluminum-filtered spectrum and 0.88 ± 0.06 for the graphite-filtered spectrum, and are within statistical uncertainties. (B.O.G.)

4615 (NP-11098(p.30-4)) BEHAVIOR OF BORON-CARBIDE RODS DURING ONE-MEGAWATT OPERATION OF THE NRL REACTOR. A. F. DiMeglio, J. O. Elliot, et al. (Naval Research Lab., Washington, D. C.).

A description is given of the outgassing of boron-carbide shim-safety rods for the NRL modified-pool reactor during 1-Mw operation. Gamma spectroscopy and coincidence-counting measurements on samples of the gas revealed a 0.5-Mev gamma ray caused by a positron activity with a half life of 20 ± 0.5 min, which was assigned to carbon-11. It was postulated that holes had developed in the rod shell allowing water to leak in, and that in the presence of B_4C the radiolytic decomposition of water was catalyzed producing gas bubbles which escaped from the rod. Special fabrication techniques are described which were used to minimize the moisture content in the construction of a new set of rods. (B.O.G.)

4616 (NP-11098(p.35-7)) DIFFUSION FROM A HEMISPHERICAL SOURCE OF SLOW NEUTRONS. W. R. Faust (Naval Research Lab., Washington, D. C.).

A method is described for the calculation of the distribution of slow neutrons around an asymmetrical source which is shielded such that neutrons are emitted uniformly only through one hemisphere. The equation describing the spatial distribution of neutron density ρ is: $\nabla^2 \rho - k^2 \rho = 0$, where ∇^2 represents the Laplacian operator, and $1/k$ is the diffusion length. (B.O.G.)

4617 (NP-11098(p.38-45)) FINITE GEOMETRY CORRECTION COEFFICIENTS FOR ANGULAR CORRELATIONS BASED ON FULL ABSORPTION OF INCIDENT GAMMA-RAY ENERGY. C. R. Gossett and Charlotte M. Davisson (Naval Research Lab., Washington, D. C.).

A discussion is given of the adaptation of Monte Carlo methods in the determination of $w(\beta)$, the probability of interaction of gamma rays as a function of the angle β between the axis of the crystal and the ray from the point source, calculated on the basis of any interaction with the crystal and for full energy absorption. Details are included

of the calculation of Q_1, the geometry correction coefficient, and the numerical results for a crystal 3-in.-diameter by 3-in.-high, a source-to-crystal-face distance of 6 cm, and incident gamma energies of 0.3 to 20 Mev. It is noted that for the case considered the data at higher energies represents only a lower limit to the values of Q_1, but represent a closer approximation to the true situation than was previously available. The results allow the consideration of a collimated geometry which was specifically forbidden in previous works. (B.O.G.)

4618 (NP-11098(p.47-52)) THE CORROSION OF STEEL IN CONCENTRATED LITHIUM HYDROXIDE SOLUTIONS AT 316°C. M. C. Bloom (Naval Research Lab., Washington, D. C.).

Observations of the corrosive effects of 28% LiOH on mild steel at 316°C revealed a series of fluctuations at a high rate prior to a final drop to lower rates after seven days. It was concluded that the high rate is caused by the destruction of the protective magnetite film, and the drop to low rates is the result of the consumption of LiOH by the reaction: $Fe_3O_4 + 3LiOH \rightarrow 3LiFeO_2 + H_2O + 1/2H_2$. Corrosion by LiOH exhibits no evidence of pit formation even after 23 days. It is pointed out that in the use of NaOH, the reaction consumes water thus increasing the NaOH concentration and corrosion rate; and in the use of LiOH the reaction consumes LiOH and generates water to decrease the LiOH concentration and corrosion rate. (B.O.G.)

4619 (NP-11143) TEMPERATURE DEPENDENCE OF THE DIELECTRIC CONSTANT OF IONIC CRYSTALS. Technical Report No. 167. Ronald Fuchs (Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research) Nov. 1961. Contracts AF19(604)-6155 and Nonr-1841(10). 36p.

Two physical processes contribute to the temperature dependence of the low-frequency dielectric constant ϵ: the effect of thermal expansion on ionic and electronic polarizabilities and density, and a pure temperature effect with the volume held constant. Calculations of the temperature coefficient due to thermal expansion, based on the Szigeti relations, can be brought into agreement with experiment, provided a correction for the volume dependence of the effective charge is made. The temperature coefficient at constant volume is affected by both the anharmonic terms in the expansion of the lattice energy as a function of ionic displacements and the nonlinear dependence of the polarization on ionic displacements. It is possible to explain qualitatively why the temperature coefficient at constant volume changes from positive to negative as the dielectric constant increases. A correlation can be made between various temperature effects and the infrared absorption spectrum. (auth)

4620 (PR-P-50) PHYSICS DIVISION PROGRESS REPORT, APRIL 1, 1961–JUNE 30, 1961. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 77p. (AECL-1337)

Nuclear Physics Research. The nucleus Ne^{20} is one of the lightest nuclei exhibiting collective oscillations and it also shows some 4-cluster or α-particle type structure. In addition, it is believed Ne^{20} plays a key role in certain reactions in the stars. For these reasons a concerted study of the low-lying excitations has been carried out using a variety of reactions induced by beams of protons, α-particles or C^{12} nuclei from the tandem accelerator. The energies, spins, parities, and radiation transition probabilities of many low excited states have been determined. The combined evidence suggests a grouping of these states into four overlapping rotational bands which implies a non-spherical shape for the Ne^{20} nucleus. Two of these bands have negative parity and may be associated with pear-shaped octupole oscillations of this light nucleus. Conduction Electrons and Lattice Vibrations in a Metal. The lattice vibrations of the ions in a metal are partially screened by the conduction electrons. Kohn, proposed on theoretical grounds, that this screening decreases abruptly at certain vibration wave numbers which are directly related to the maximum momenta of the conduction electrons in the metal. Lattice vibration studies have been carried out on a single crystal of lead using the triple axis neutron spectrometer at NRU. Sudden changes in the slopes of the frequency wave-number dispersion curves are observed. Some of these anomalies have been correlated with known features of the conduction electron momentum surface of lead and it is believed that they are indeed the Kohn anomalies. The observed intensity of the anomalies gives direct information on the interaction between the lattice vibrations and the conduction electrons. Electronics. The accumulated knowledge and experience gained on transistor switching circuits is being employed to reduce development effort on many experimental equipments of the data processing type. A report has been written which lists and describes many of the versatile printed circuit boards developed recently and this will be used directly to simplify the design and fabrication of a system. Studies of a general purpose large counting and analyzing machine which can be shared simultaneously by many experimenters have commenced and details of the organization of such a machine are being worked out. Much of this work overlaps work on the reactor monitoring and data processing system and it is expected that some pooling of effort and equipment will take place between the two programs during the development phase. (auth)

4621 (AEC-tr-4883) YIELD MEASUREMENTS IN THE COLLISION OF SLOW ELECTRONS WITH THE ATOMS OF NOBLE GASES. Heinz Maier-Leibnitz. Translated by Lydia Venters (Argonne National Lab.) from Z. Physik, 95: No. 7/8, 499(1935). 25p.

The excitation of helium, neon, and argon by means of electron impact was investigated with the aid of an electric multiple-collision method. In order to measure with good accuracy the total yield of an impact at low electron velocity, the possibility of exciting all terms together, two methods were used. Yields of several per cent were obtained, and several statements concerning the excitation functions of individual terms were made. Very steep yield peaks within 1v over the excitation potential were also obtained. (auth)

4622 (CEA-tr-R-1412) ETUDE DES DENSITES D'ATOMES EXCITES ET DES TEMPERATURES DES GAZ INERTES DANS UNE COLONNE POSITIVE DE DECHARGE. (Study of Densities of Excited Atoms and Temperatures of Inert Gases in Positive Discharge Columns). K. S. Mustafin. Translated into French from Vestnik Leningrad. Univ. 15, No. 22, Ser. Fiz. i Khim. No. 4, 130-7(1960). 23p.

A study was made of the population density of the higher levels of neon and of gas temperature measurement in neon and argon. Knowledge of the gas temperature is necessary for the evaluation of the measurements obtained by probing. A 20-mm diameter discharge tube with a window for optical measurements and 3 electrodes for different column lengths was used. (T.R.H.)

4623 (FTD-TT-61-104) THE MOTION OF A CONDUCTING GAS IN A MAGNETOGASDYNAMIC GENERATOR. O. A. Berezin. Translated from Vestnik Leningrad. Univ.,

16: No. 13, Ser. Mat., Mekhan. i Astron., No. 3, 93-102 (1960). 14p.

Two-dimensional stationary motion of a nonviscous and thermally nonconductive, conducting gas from a stationary source was examined. It was assumed that at sufficiently long times the diagram of the motion of a conducting gas in a magnetogasdynamic generator differs little from the equilibrated one. Boundary conditions of the normality of magnetic lines of force of the additional magnetic field at the surface of the poles, which were assumed to be the walls of the channel, were set up. (M.C.G.)

4624 (SCL-T-389) FORCED VIBRATIONS (OSCILLATIONS) WITH VISCOUS FRICTION AND COULOMB DAMPING. Ettore Funaioli. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Riv. ing., 4: No. 2, 165-71(Feb. 1954). 20p.

A study was made of forced oscillations by periodic excitation in a system with one degree of freedom and in the presence of a viscous friction and coulomb damping. Responses of the system to rectangular and "Greek key" impulses are treated. Approximate solutions are derived, and two numerical examples are given in which the velocity changes sign four and two times in a period. (D.L.C.)

4625 (UCRL-Trans-731(L)) STUDY OF THE TEMPERATURE JUMP IN RAREFIED GASES. S. I. Gribkova. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Vestnik Moskov. Univ. Ser. III, 15: No. 4, 59-63(1960). 12p.

The results of experiments on measurement of heat flow across a cylindrical layer of rarefied gas are presented. The coefficients of the temperature jump were determined at the border of the rarefied gas and solid wall for air and a series of monoatomic gases. The amount of the temperature jump was studied as a function of the surface temperature. (auth)

4626 (UCRL-Trans-749(L)) ATOMIC FACTOR FOR X-RAYS AS A PROBLEM OF THE DISPERSION THEORY (K-SHELL). H. Hoenl. Translated by S. Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore) from Ann. Physik (5) 18: 625-55(1933). 57p. (Includes original, 32p.).

The atom factor for x-rays is interpreted as a dispersion problem in such a way that the theory of geometric interference is valid. The atom moment determinative for the coherent scattering radiation, which in the Waller dispersion formula is composed of two terms, is discussed. The dipole term of the K shell is shown to be adequate for the computation of F curves, and the results are compared with literature data. (D.L.C.)

4627 APPROXIMATE CROSS-SECTIONS FOR INELASTIC COLLISIONS OF ELECTRONS WITH ATOMS. II. FORBIDDEN TRANSITIONS. Joseph H. Scanlon and S. N. Milford (St. John's Univ., Jamaica, N. Y.). Astrophys. J., 134: 724-32(Nov. 1961).

A method for finding very simple approximate electron-atom cross-sections for allowed transitions is extended to forbidden transitions. From the high-energy properties of cross-sections and the form of the cross-section at its maximum, an expression is obtained for the momentum cutoff in terms of ϵ_1, the energy at which the maximum occurs. The multipole expansion gives a simple approximate formula for the cross-section σ, in the region $\epsilon \geq \epsilon_1$, in terms of the quadrupole moment determined from experiment or calculation; the threshold shape is adopted for $\epsilon < \epsilon_1$. The curve for $\sigma(\epsilon_1)$ is found to cross the Born curves within 10 per cent of the Born maxima for several forbidden transitions in hydrogen. With the particular method used for estimating ϵ_1, in the region $\epsilon > \epsilon_1$ the simple $\sigma(\epsilon)$ formula satisfactorily reproduces the Born values for the $\Delta n = 1$, but not the $\Delta n = 2$, transitions considered. For use in this and other approximation methods, Born and Bethe cross-sections were calculated for seven forbidden and three allowed transitions in hydrogen, namely, 1s-2s, 3s; 2s-3s, 3p, 3d, 4s; and 2p-3s, 3p, 3d, 4f. (auth)

4628 THE SUITABILITY OF MATERIALS USED FOR THE MEASUREMENT OF THE HALF-VALUE THICKNESS FOR X-RAY BEAMS. D. E. A. Jones (Mount Vernon Hospital, Northwood, Middx., Eng. and Radium Inst., Northwood, Middx., Eng.). Brit. J. Radiol., 34: 801-6(Dec. 1961).

The suitability of aluminum, copper, tin, and lead for x-ray attenuation and half-value thickness measurements is critically examined in the light of the possible influence upon the measurements of variation in density and of the occurrence of impurities in commercially available materials. The ranges of energy over which these materials may be used so as to yield unequivocal information is also discussed. It is demonstrated experimentally that both aluminum and copper are as suitable as lead for attenuation measurements on Co^{60} γ rays, and that filter thickness per se is not a disadvantage in such measurements. It is further suggested that since aluminum may be usefully employed at energies higher than those suitable for copper or lead, it should be the material of choice over the entire energy range for which half-value thickness is a useful index of quality. (auth)

4629 COMPRESSIBILITY OF LIQUID He^4. M. H. Edwards and W. C. Woodbury (Royal Military Coll., Kingston, Ont.). Can. J. Phys., 39: 1833-41(Dec. 1961).

The refractive index n, density ρ, and isothermal compressibility $k_T = (1/\rho) \times (\partial\rho/\partial P)_T$ of liquid He^4 were measured along isotherms between the saturated vapor pressure and 4.5 atmospheres at 3.0°, 3.5°, 4.0°, 4.5°, and 5.0°K. The liquid was compressed in an optical cell 9.58 cm long in a Jamin interferometer. Changes in density were inferred through the Lorenz-Lorentz equation from refractive index changes measured with a photomultiplier fringe recorder. One fringe corresponds to a change in refractive index of $(5.699 \pm 0.003) \times 10^{-6}$ in this apparatus. Densities range between 0.0995 g cm^{-3} at 5.0°K at the saturated vapor pressure and 0.1501 g cm^{-3} at 3.0°K and 4.5 atmospheres pressure. Compressibilities range between 65×10^{-6} cm^2 $dyne^{-1}$ at 5.0°K at the saturated vapor pressure and 1.16×10^{-5} cm^2 $dyne^{-1}$ at 3.0°K and 4.5 atmospheres pressure. The limiting liquid structure factors for zero-angle x-ray scattering and for coherent scattering of slow neutrons were calculated from these density and compressibility measurements. In addition, the ratio of heat capacities was calculated at 3.0°, 3.5°, and 4.0°K where other measurements of the velocity of first sound are available. (auth)

4630 SCINTILLATION SPECTRA FROM THICK SOURCES. K. G. McNeill and R. M. Green (Univ. of Toronto). Can. J. Phys., 39: 1842-50(Dec. 1961).

Graphs are presented showing the variation of different characteristics of scintillation spectra when the thickness of the source is altered. Correlation curves between the valley-to-peak ratio and the other characteristics enable tests to be made to decide whether or not changes such as the apparent change in resolution of a spectrum from the resolution obtained with a point source is due to the thickness of the source or to the presence of secondary gamma rays. (auth)

4631 DIRECT MEASUREMENT OF CHARGED PARTICLES ASSOCIATED WITH AURORAL ZONE RADIO ABSORPTION. I. B. McDiarmid, D. C. Rose, and E. Budzinski

(National Research Council, Ottawa). Can. J. Phys., 39: 1888-1900(Dec. 1961). (NRC-6577)

A rocket experiment to study the charged particles associated with auroral radio absorption is described. A primary electron flux, probably in the form of beams or columns, with a maximum intensity of 2×10^6 particles cm^{-2} sec^{-1} was observed. The integral electron energy spectrum could be represented by exp (–E/22 kev) at energies above 30 kev. The angular distribution of the incident electrons was approximately isotropic over the upper hemisphere. Two other types of angular distributions, involving large intensities of upward-moving particles, were observed. The measured electron flux was sufficient to account for the observed radio absorption. Protons in the energy range greater than 500 kev were recorded with a maximum intensity of 6×10^2 particles cm^{-2} sec^{-1} $sterad^{-1}$. The proton intensity was relatively steady and was not correlated with the electron flux either in space or in time. (auth)

4632 NEW OBSERVATIONS ON THE X SPECTRA OF PLUTONIUM. Yvette Cauchois, Louis de Bersuder, and Ioana Manescu. Compt. rend., 253: 1042-3(Aug. 21, 1961). (In French)

As a continuation of preliminary works on the X spectra of plutonium, the L absorption spectra were analyzed with the aid of autonomous samples consisting of thermally evaporated metallic plutonium, protected against oxidation by aluminum deposits, plastic envelopes, and maintenance under argon. Combined with previous determinations of emission frequencies, the measurements should give the energy levels almost to several electron volts. (tr-auth)

4633 NEUTRALIZATION OF AN ION BEAM BY ELECTRON INJECTION: GENERAL SOLUTIONS DEPENDENT ON TIME. Jean-Michel Dolique. Compt. rend., 253: 1091-3(Aug. 28, 1961). (In French)

In a previous article (Compt. rend. 253: 818(1961)), the neutralization of an ion beam by electron injection was studied, the study being limited to solutions independent of time. These solutions exist only if, at the injection level, the densities of the electron and ion current are equal and if the band length of the spectra of electron velocities is less than the mean ion velocity. In problems of ion propulsion, this last condition has never been realized. Therefore one is led to the study of general solutions dependent on time, which is the object of the present article. (tr-auth)

4634 ON THE VAVILOV-ČERENKOV RADIATION IN UNIAXIAL CRYSTALS. Č. Muzikář and V. E. Pafomov (Joint Inst. for Nuclear Research, Dubna, USSR). Czechoslov. J. Phys., B 11: 709-10(1961). (In Russian)

An investigation is made of the Vavilov-Cherenkov radiation energy in uniaxial magnetic crystals and in uniaxial crystals with double anisotropy. (auth)

4635 ANGULAR DISTRIBUTION OF PHOTOELECTRONS KNOCKED OUT FROM Ag AND Bi TARGETS BY Cs^{137} γ RAYS. K. K. Aglintsev, V. V. Metrofanov, A. A. Rimskii-Korsakov, and V. V. Smirnov. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1141-5(Sept. 1961). (In Russian)

A Ritron-type magnetic spectrometer was used in an investigation of the angular distribution of photoelectrons knocked from thin layers (0.05 mg cm^{-2}) of silver and bismuth by Cs^{137} γ rays. The experimental data are correlated with theory. (R.V.J.)

4636 PHOTOVOLTAIC EFFECTS IN Cs_3Sb FILMS. Frederick Wooten (Univ. of California, Livermore). J. Appl. Phys., 32: 1789-90(Sept. 1961). (UCRL-6353)

Some photovoltaic effects observed in Cs_3Sb films, their implications with regard to band bending, and the influence of band bending on photoemission are reported. When the Cs_3Sb films were scanned with a small light spot (20μ in diameter) from one electrode to the other, photovoltaic effects were frequently observed. These effects could nearly always be correlated with the presence of either scratches (<5μ wide) in the glass substrate or of small specks of CeO_2 (5μ in diameter) used as a glass polishing agent. Because the imperfections are small, band bending in the vicinity of these imperfections is a three-dimensional effect. It thus has a component parallel to the film (which results in the photovoltaic effects reported) and also a normal component. The photovoltaic effects are illustrated. (P.C.H.)

4637 WAVELENGTH SHIFTS IN Hg^{198} AS A FUNCTION OF TEMPERATURE. Sayeda H. Emara. J. Research Natl. Bur. Standards, 65A: 473-4(Nov.-Dec. 1961).

The wavelength shifts for the green (5460A) and blue (4358A) lines emitted from an electrodeless discharge lamp of Hg^{198} were studied as a function of the temperature of the water jacket of the source. The values of the wavelength shifts observed for the green and the blue lines are (8.5 ± 3) 10^{-6} A/°C and (2 ± 1) 10^{-6} A/°C, respectively. (auth)

4638 EXCITATION OF THE 2s STATE OF ATOMIC HYDROGEN BY ELECTRON IMPACT. B. L. Moiseiwitsch (Queen's Univ., Belfast). Nature, 192: 545(Nov. 11, 1961).

Comparisons are made of the calculations of the total cross-section Q(1s–2s) for the 1s–2s excitation of hydrogen atoms by electron impact. Comparisons are made primarily for the curve obtained by Kingston, Moiseiwitsch, and Skinner in which they applied the second Born approximation, retaining only terms up to the third order in the interaction energy. (N.W.R.)

4639 EMISSION OF ULTRA-VIOLET AND VISIBLE RADIATION FROM METALS BY THE IMPACT OF HIGH-ENERGY HYDROGEN IONS. Rafi Mohammed Chaudhri and Mustafa Yar Khan (Government Coll., Lahore, W. Pakistan). Nature, 192: 646-7(Nov. 18, 1961).

The probable mechanism of the emission of ultraviolet and visible radiation from a nickel target by the impact of high-energy positive ions of hydrogen is investigated. The experimental method is described and the distribution curve of spectral intensity is graphically presented. The presence of the peak (4600 to 4800 Å) in the region of prominent nickel lines for the target cooled to low temperature leads one to think that this radiation is emitted from the excited atoms which originate in the metal itself under the impact of the high-energy positive ions. The continuous nature of the spectrum, on the other hand, suggests that some sort of electron plasma oscillations may occur in the metal due to positive ion bombardment on it, and may give rise to this radiation. (N.W.R.)

4640 EXPERIMENTAL DETECTION OF AUTO-IONIZING TRANSITIONS IN KRYPTON BY ELECTRON IMPACT. John F. Burns (Oak Ridge National Lab., Tenn.). Nature, 192: 651-2(Nov. 18, 1961).

The contribution of auto-ionization to the shape of the ionization efficiency curves obtained by electron impact is examined. The ionization efficiency curves presented for the krypton positive ion exhibit discontinuities in slope at electron energies that lie quite close to the levels found in absorption. Both the intensity and separation of these levels fall off rather rapidly at higher energies, so that only those that lie directly above the normal $^2P^0_{\frac{1}{2}}$ ionization level can be expected to be resolved. Three independent determinations of the ionization efficiency curve are shown. (N.W.R.)

4641 THE ELECTRIC FIELD IN SINGLE-TURN AND MULTI-SECTOR BOILS. J. E. Allen and S. E. Segre

(EURATOM–C.N.E.N., Laboratori Nazionali Frascati, Italy). Nuovo cimento (10), 21: 980-7(Sept. 16, 1961). (In English)

Calculations of the distribution of electric field within long single-turn and multi-sector coils are reported. Some of the calculations refer to coils containing a cylindrical conductor, the latter representing an idealized plasma. (auth)

4642 HEAT CONDUCTION BY LIQUID HELIUM II IN CAPILLARY TUBES. II. MEASUREMENTS OF THE PRESSURE GRADIENT. D. F. Brewer and D. O. Edwards (Clarendon Lab., Oxford). Phil. Mag. (8), 6: 1173-81(Sept. 1961).

The pressure and temperature gradients accompanying heat flow in liquid helium II were measured simultaneously. The experiments were made in a glass tube of 107.6μ diameter and 10.2 cm length between 1.3 and 1.8°K. Significant deviations from Allen and Reekie's rule were observed and are provisionally attributed to an eddy viscosity, η_e, due to turbulence in the superfluid component. An equation, based on dimensional arguments, is proposed for η_e which satisfactorily represents the experimental data available at present. (auth)

4643 THE POSITIVE ION BOMBARDMENT OF EVAPORATED SINGLE CRYSTAL GOLD FILMS. E. Gillam and M. Phillips (General Electric Co. Ltd., Wembley, Eng.). Phil. Mag. (8), 6: 1185-7(Sept. 1961).

Evaporated single-crystal gold films were subjected to ion bombardment in an argon discharge under the following conditions: voltage, 300 v; current density, 0.15 ma/cm^2; bombardment time, 1 hr; and pressure, 0.6×10^{-3} torr. The films, initially 2000 Å thick, were found to be ~500 Å thick, corresponding to a sputtering ratio on the order of 0.1 atoms removed per incident positive ion. Electron diffraction patterns show that no arcing of the spots occurs except near the edge and it is proposed that misorientations are caused by the further thinning of the already thin and twisted edge by the ion bombardment. Annealing of a bombarded film results in the disappearance of the specks and the formation of complex dislocation networks. (D.L.C.)

4644 NOTE ON THE SCATTERING OF ELECTRONS BY STACKING FAULTS IN LITHIUM. J. S. Dugdale and D. Gugan (National Research Council, Ottawa). Phil. Mag. (8), 6: 1189-90(Sept. 1961).

A consideration of the electrical resistivity of the low-temperature phase of lithium shows that stacking-fault scattering of electrons is small in lithium, which is contrary to expectations. (D.L.C.)

4645 A POSSIBLE EXPLANATION OF THE RESULTS OF THE PRECEDING NOTE REGARDING SCATTERING OF ELECTRONS BY STACKING FAULTS IN LITHIUM. A. Howie (Cavendish Lab., Cambridge, Eng.). Phil. Mag. (8), 6: 1191-2(Sept. 1961).

Several possible causes are pointed out for the small value of the resistivity of stacking faults in lithium as compared to that in noble metals. It is concluded that the small value can be understood without changing the theory of how stacking faults scatter electrons. (D.L.C.)

4646 A NOTE ON THERMOELECTRIC POWER AND INELASTIC SCATTERING. A. M Guénault and D. K. C. MacDonald (National Research Council, Ottawa). Phil. Mag. (8), 6: 1201-6(Oct. 1961).

Kasuya, Bailyn, and de Vroomen independently proposed that spin-dependent scattering of electrons by magnetic impurity ions would provide a mechanism to account for the "giant" thermoelectric powers observed in certain dilute alloys at very low temperatures. A simplified model indicates directly that the essential requirement is that of two largely independent groups of conduction electrons whose mobilities are significantly different, but in which the groups are coupled by (spin-dependent) inelastic scattering. It also follows in general agreement with experiment that resistive anomalies are to be looked for when such "mutual electron-drag" is present. (auth)

4647 SIMPLIFIED MODEL OF LIQUID HELIUM. K. Sawada and R. Vasudevan (Univ. of California, La Jolla). Phys. Rev., 124: 300-7(Oct. 15, 1961).

A simplified version of a Bose gas with negative scattering length is studied with a model Hamiltonian similar to that used in the case of repulsive interactions. A new transformation is used which takes into account the attractive interactions in the system, and the ground-state energy is calculated from experimental values of the sound velocity in the system. Real values for the phonon energy spectrum are obtained, and the ratio of the effective mass to ordinary mass is deduced using experimental values of interparticle separation and core radius. A justification for using this modified Hamiltonian is attempted. (auth)

4648 NUCLEAR MAGNETIC RESONANCE OF Cr^{53} IN ANTIFERROMAGNETIC $CrCl_3$. A. Narath (Sandia Corp., Albuquerque, N. Mex.). Phys. Rev. Letters, 7: 410-11 (Dec. 1, 1961).

Observations of the Cr^{53} nuclear magnetic resonance in $CrCl_3$ at 1.23 to 4.02°K and zero external field are reported. Results of precision measurements of the frequency for resonance are in excellent agreement with the predictions of simple wave theory for a two-dimensional ferromagnetic system in the presence of anisotropy. (L.N.N.)

4649 A SCHEMATIC MODEL FOR THE IMPACT EXCITATION OF ATOMS. B. L. Moiseiwitsch (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 78: 661-72 (Nov. 1, 1961).

The third-order approximation is used to derive simple analytical expressions for the partial cross sections corresponding to the scattering of high-energy charged particles by a schematic model atom involving matrix elements having a r^{-2} radial dependence. (auth)

4650 PULVERIZATION OF METALS BY FAST DEUTERIUM IONS. V. D. Tishchenko (Shevchenko State Univ., Kiev). Ukrain. Fiz. Zhur., 6: 417-18(May-June 1961). (In Ukrainian)

Interaction of fast D ions with metallic walls, in particular the phenomenon of cathodic pulverization plays a great role in the development of experimental techniques in the field of thermonuclear investigations which include high-vacuum studies. This problem was investigated by using metallic Co as structural material, incorporating Co^{60} in it. Results indicated that such an isotopic method is quite useful in the region of small pulverization coefficients. A high-frequency source with transversal high-frequency and longitudinal magnetic fields was used for generating the D ions; the concentration of atomic D ions in such a source may reach or even exceed 80%. Results indicate that the presence of less than 20% of molecular D ions in the beam does not substantially affect the measurements. The energy region ranging from 39 to 122.2 kev was investigated; the pulverization coefficients obtained presented a smooth curve decreasing from 6.6×10^{-3} to 3.6×10^{-3} atoms/ion. (TTT)

4651 IONIZATION AND ACCELERATION OF CONDENSED MOLECULAR BEAMS. W. Henkes (Kernforschungszentrum, Karlsruhe, Ger. and Technische Hoch-

schule [Karlsruhe, Ger.]). Z. Naturforsch., 16a: 842 (Aug. 1961). (In German)

A study was made to determine if particles cohering by van der Waal force could be ionized and electrically accelerated. A condensed CO_2 beam produced with a convergent nozzle at room temperature was modulated and then bombarded with 175 ev electrons. The ions formed were electrically accelerated, focused, and deflected in a 6000 gauss field. The results showed that the beam region cohering through van der Waal forces can be ionized by electron bombardment and then can be deflected or accelerated in electrical and magnetic fields. (J.S.R.)

4652 THE FREQUENCY OF THE HELIUM AND NEON ISOTOPES PRODUCED BY COSMIC RADIATION IN SOME IRON METEORITES. T. Hayakawa, H. Hintenberger, and H. Waenke (Max-Planck-Institut für Chemie, Mainz). Z. Naturforsch., 16a: 844(Aug. 1961). (In German)

The results obtained from the measurement of the He and Ne isotope abundancies in the iron meteorites Clark County, Thunda, Treysa, Carbo, and Bendego are tabulated The He^3/Ne^{21} ratio showed a systematic increase with increasing meteorite mass, which can be explained by the deep effect of He^3. (J.S.R.)

4653 EXPERIMENTAL CRYOPHYSICS. F. E. Hoare, L. C. Jackson, and N. Kurti, eds. London, Butterworths, 1961. 398p. $14.00.

A collection of ten review articles is presented on many technical problems in the field of low-temperature physics. The articles deal with laboratory equipment, gas liquefaction, magnetic cooling, thermometry, and various techniques. Copious bibliographies are included. (D.L.C.)

4654 THE THEORY OF CRYSTAL STRUCTURE ANALYSIS. A. I. Kitaigorodskii. Translated from the Russian by David Harker and Katherine Harker. New York, Consultants Bureau, 1961. 283p. $12.50.

A treatment is presented on the theory of methods of finding the crystal structure from x-ray or electron diffraction data. Relationships between structure amplitudes are discussed. (D.L.C.)

4655 MAGNETIC TRANSITIONS. K. P. Belov. Authorized Translation from the Russian by W. H. Furry. New York, Consultants Bureau, 1961. 253p. $12.50

Phenomena in the vicinity of the temperatures of magnetic transitions (e.g. near the Curie point) in ferromagnetic, ferrimagnetic, and antiferromagnetic materials are examined by a thermodynamic method. Major attention is devoted to the magnetic phenomena in this temperature range, but associated effects (magnetoelastic effects, magnetostriction, etc.) are also studied. Methods for measuring magnetic and magnetic-associated effects in the vicinity of transitions are discussed. (T.F.H.)

Astrophysics and Cosmology

4656 (AFSWC-TR-61-82) ANALYSIS OF JASON DATA. Final Report. (Lockheed Aircraft Corp. Missiles and Space Div., Sunnyvale, Calif.). Oct. 1961. Contract AF29(601)-2862. 142p.

Data obtained by Jason sounding rockets during the Argus tests are investigated. These instrumented rockets detect electrons that are injected into the geomagnetic field by the detonation of nuclear devices at high altitudes. The investigations yield the orientations of the detectors with respect to a plane perpendicular to local magnetic lines of force; the calibration of the detectors in a planar flux of electrons as functions of electron energy and orientation of the detectors with respect to the electron plane; and a re-evaluation of the Jason data based on the first two results and on recent data on characteristics of the natural radiation. The conclusions yield the location, width, and stability of the electron "shell" produced by the Argus II detonation, as well as the presence of a less intense electron flux in wide regions (wings) away from the shell. This electron spectrum is in agreement with the fission beta spectrum. Within the accuracy of the data, the spectrum is found to be independent of the spatial locations of the rockets or of time. The decay of the flux appears to follow a time dependence of $t^{-1.15 \pm .09}$, and a lower limit to the injection efficiency appears to be 0.013. (auth)

4657 MODELS FOR ZERO-TEMPERATURE STARS. T. Hamada (Univ. of Sydney) and E. E. Salpeter. Astrophys. J., 134: 683-98(Nov. 1961).

The equation of state previously derived (E. E. Salpeter, Astrophysical Jour. 134, 669-82(1961)) is applied to models for zero-temperature stars. Models are evaluated numerically for stars consisting of He^4, C^{12}, Mg^{24}, Si^{28}, S^{32}, or Fe^{56}. For the same central density, ρ_c, these models have smaller values of radius R and mass M than the simpler Chandrasekhar models. These deviations are most marked at the lowest densities (of about 20% for $\rho_c \sim 10^5$ gm/cm^3, M ~ 0.1 M$\odot$). For models with high density the most important effects are due to inverse beta decays in the interior of the star. Instead of the Chandrasekhar limiting mass (1.46 M$\odot$ for He^4) as $\rho_c \to \infty$, a maximum value of mass M for a finite value of ρ_c is obtained. The value of this maximum mass depends on initial chemical composition. The lowest possible value is 1.01 M$\odot$ for the optimum chemical composition, the value of this maximum mass for Fe^{56} is 1.11 M$\odot$ and is largest for C^{12} (1.40 M$\odot$). The values of ρ_c for the maximum mass are in the range 10^9 to 10^{10} gm/cm^3. Models are constructed for zero-temperature stars which contain a hydrogen envelope. The presence of such an envelope increases the radius of the star but has little effect on the mass. For the more massive stars (M $\gtrsim$ 0.7 M$\odot$), only small hydrogen envelopes are possible. Models are constructed for neutron stars ($\rho_c > 10^{13}$) containing a neutron core and an envelope consisting of electrons and ions. For $\rho_c < 3 \times 10^{14}$ the envelope contains most of the mass (M > 0.5 M$\odot$). A sharp minimum mass of about 0.05 M$\odot$ is obtained at $\rho_c \sim 3.5 \times 10^{14}$, and for larger ρ_c the envelope is unimportant. (auth)

4658 THE EXISTENCE OF He^3 IN 3 CENTAURI A. W[allace] L. W. Sargent and Jun Jagaku (Mount Wilson and Palomar Observatories [Pasadena, Calif.]). Astrophys. J. 134: 777-82(Nov. 1961).

The positions of 10 He I lines were measured on 5 high-dispersion plates of 3 Centauri A (B4p). Some of the lines are displaced lengthwise of their normal wavelengths by up to 0.39 A. There is a good correlation between the observed shifts and the isotope shifts for He^3. On comparing the displacements in 3 Centauri with those measured in other B stars, it is concluded that the Stark effect cannot produce shifts of the magnitude observed in 3 Centauri. Using the simple approximation that the observed displacements are proportional to the ratio $He^3/(He^3 + He^4)$, it is found that this ratio in 3 Centauri is 0.84 ± 0.10. From a study of the profile of $H\gamma$ measured on 3 plates, it is found that the ratio deuterium : hydrogen is less than about 0.01. Possible ways in which He^3 could be produced in large quantities in the atmosphere of 3 Centauri are considered. (auth)

4659 AN ABUNDANCE ANALYSIS OF 3 CENTAURI A. Jun Jugaku, Wallace L. W. Sargent, and Jesse L. Green-

stein (Mount Wilson and Palomar Observatories [Pasadena, Calif.]). Astrophys. J., 134: 783-96(Nov. 1961).

Abundances in 3 Centauri A (B4 IV or Vp) are derived, using γ Pegasi (B2 IV) as a standard comparison star and the approximation of a single-layer atmosphere. The abundances of elements (P, Ca, Ga, and Kr) not observed or observed only weakly in γ Pegasi are derived relative to Si in 3 Centauri A. C, Ne, Si, Ar, and Ca have normal abundances. He and O are underabundant by a factor of 6 in 3 Centauri A; N is overabundant by a factor of 5; P by a factor of 100; Fe by a factor of 4; and Kr by a factor of about 1300. An identification not yet certain of Ga II leads to an overabundance of about 8000 for Ga. Upper limits for the abundances of Al, S, Cl, Zn, Ge, As, Se, Br, Rb, and Sr are derived. Of these, S is deficient by a factor of more than about 10. It is likely that Ga and Kr are local abundance peaks but that other elements in the same region of the periodic table could be almost as overabundant without being detected spectroscopically. It is conjectured that these abundance anomalies, together with the large concentration of He^3 reported previously, are produced by the acceleration of particles on the surface of 3 Cen A. H. W. Babcock did not detect a regular magnetic field in the star, although it is probably related to the "manganese" stars which have magnetic fields. (auth)

4660 ON THE ORIGIN OF RADIO EMISSION FROM COSMIC GAS CLOUDS. P. F. Browne (Univ. of Manchester, Eng.). Astrophys. J., 134: 963-9(Nov. 1961).

It is shown that the delicate balance between absorption and stimulated emission for free-free transitions in a gas plasma can lead to a negative as well as a positive "effective" absorption coefficient and hence to amplification of the spontaneous emission. (auth)

4661 PRODUCTION OF THE RARE LIGHT ELEMENTS. S. Bashkin and D. C. Peaslee (Australian National Univ., Canberra). Astrophys. J., 134: 981-94(Nov. 1961).

The rare light isotopes H^2, He^3, Li, Be, and B are discussed in terms of spallation reactions in stellar surfaces by locally produced high-energy particles. This activity appears to be most intense during the ignition or T Tauri stage of a star. Present terrestrial abundances of Li, Be, and B are ascribed to solar activity of this magnitude during the period of formation of the solar system. The high terrestrial abundance of deuterium is associated with concentration effects in the primordial dust grains from which the plants accreted; the general abundance of deuterium should be much lower. It is not proved possible to decide whether the abundances of rare light isotopes observed in the sun reflect current production by solar flares or are the unburned remnants of an original stock; the large solar Be/Li ratio is anomalous on present considerations, and no explanation is offered. (auth)

Cosmic Radiation

4662 (AFCRL-659) ON THE PRESSURE DEPENDENCE OF THE COSMIC RAY INTENSITY RECORDED BY THE STANDARD NEUTRON MONITOR. Technical Note No. 7. Stig Lindgren (Uppsala Univ. Inst. of Physics). Apr. 7, 1961. Contract AF61(514)-1312. 12p.

The pressure coefficients were determined for some standard neutron monitors at high latitudes for the years 1957-1959 with due regard to variations of primary origin. The following coefficients were obtained: 1) for Murchison Bay and Uppsala $\bar{\alpha} = -0.710 \pm 0.006\%$/mb; 2) for Resolute, Churchill and Ottawa $\bar{\alpha} = -0.725 \pm 0.005\%$/mb; 3) for Mawson and Mt. Wellington $\bar{\alpha} = -0.736 \pm 0.004\%$/mb. The differences in α between the three groups of stations are certainly real to some extent. They probably reflect dissimilarities in the neutron monitors and the pressure recording devices. As a by-product it has proved that for two stations above the latitude knee, the quotient between the pressure corrected daily neutron intensities is remarkably constant in time. It can thus be used as a sensitive indicator of changes in counting rate. (auth)

4663 (AFCRL-854) COSMIC RAY INTENSITY VARIATIONS DURING 1960. Technical (Scientific) Note No. 8. A. E. Sandstroem, E. Dyring, B. O. Groenkvist, and S. Lindgren (Uppsala Univ. Inst. of Physics). Apr. 1961. Contract AF61(514)-1312. 53p.

A continuation is given of 12th Status Report and Technical Note No. 4, which contains tables and clock diagrams of the first and second harmonics of the daily variation during 1960. Two more 12-monthly periods are included, one ending on Apr. 30, 1960 and the other on Aug. 31, 1960. The cosmic ray storms, Forbush decreases, during 1960 are displayed in diagrams over the intensity variations in per cent of a "normal" counting rate. The note contains also detailed diagrams of the solar flare effect on May 4, 1960. (auth)

4664 (AFCRL-857) COSMIC RAY FLUCTUATIONS IN THE NUCLEONIC AND MESON COMPONENTS IN UPPSALA DURING NOVEMBER 10-22, 1960. Technical Note No. 9. Eric Dyring (Uppsala Univ. Inst. of Physics). May 25, 1961. Contract AF61(514)-1312. 11p.

The large cosmic ray fluctuations during the period Nov. 10 to 22, 1960 in the nucleonic and meson component seen by the Uppsala Cosmic Ray Station are presented in 5- or 15-min values as well as 1-hour values. Correlation is made with sun and geomagnetic data. Some comparisons are made with other stations. (auth)

4665 (D1-82-0116) RADIATION BELT PARTICLE ORBITS. Harold Liemohn (Boeing Scientific Research Labs., Seattle). June 1961. 61p.

The first-order theory of radiation belt particle orbits is reviewed. Certain general characteristics of the radiation belts, the exosphere, and the geomagnetic field which are important in orbit calculations are discussed. The equations for charged particle orbits in slowly varying magnetic fields are developed from elementary principles. These results are applied to particle motion in the geomagnetic field. The orbit equations and related parameters are derived for the geomagnetic dipole model. The values of the orbit integrals for the dipole case are given in tabular and graphical form. (auth)

4666 (D1-82-0117) PROTON LIFETIMES IN THE VAN ALLEN RADIATION BELTS. Harold Liemohn (Boeing Scientific Research Labs., Seattle). June 1961. 23p.

Several loss mechanisms limit the lifetimes of protons in the inner and outer Van Allen radiation belts. During geomagnetically quiet periods the principal mechanisms are believed to be charge exchange and coulomb scattering. Specific density models for the neutral and charged components of the background exosphere are employed in order to make an absolute comparison of these two mechanisms. It is shown that charge exchange is dominant for proton energies from 2 to 200 kev giving equatorial lifetimes of about one day in the outer belt. At higher energies the protons have lifetimes of the order of years from these loss mechanisms. The dependence of the lifetimes on the mirror latitude λ_m of the trapped protons is given approximately by $\cos^6 \lambda_m$. (auth)

4667 (RADC-TN-61-87) AN ANALYSIS OF COSMIC NOISE IN X-RAY COMMUNICATION SYSTEMS. Charles A. Ziegler and John Kirkbride (Tracerlab, Inc., Waltham, Mass.). Apr. 20, 1960. Contract AF30(602)-2189. 75p. (AD-257827)

The basic observations and theory of cosmic rays, geomagnetically trapped corpuscular radiation, and radiation from the sun are studied. The effects of these types of radiations on communications systems utilizing x rays are examined. As a result of air absorption of x rays, and of the existence of the radiation areas, it is found that the primary uses of x ray communications systems must be in the intervals from 250 to 600 km and from 85000 km into cislunar space. Radiation effects on the transmitting and receiving components, as well as radiation background effects, are considered. (T.F.H.)

4668 (TID-14266) THE MAGNETIC FIELDS IN INTERPLANETARY SPACE AS DERIVED FROM OBSERVATIONS OF COSMIC RAY SOLAR FLARE EFFECTS. K. G. McCracken (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science) and R. A. R. Palmeira (Rio de Janeiro. Centro Brasileiro de Pesquisas Fisicas). 1961. 18p. (Notas de Fisica Vol. VII, No. 15. p.313-29).

A study was made of the manner in which the cosmic ray intensity observed at the earth varies with time subsequent to the production of cosmic radiation by a solar flare. It is shown that the time scales of any two flare effects can be markedly different. A quantitative comparison revealed that the flares responsible for the four flare increases exhibiting the shortest time scales occurred on the western solar limb, while the four responsible for the increases with the longest time scales occurred near the center, or on the eastern portion of the solar disc. These facts are shown to be consistent with a theoretical model for the interplanetary magnetic fields. The proposed model predicts that impact zones will be pronounced for a flare on the western limb, and poorly defined for one near the center of the solar disc, predictions which are shown to be in accord with the observations. Considering the flare effect of May 4, 1960, it is shown that the apparent source of the cosmic radiation lay in a direction about 60° to the west of the earth-sun line. This is interpreted as indicating that in the vicinity of the earth, the lines of force of the interplanetary magnetic field were inclined to the earth-sun line by about 60° on May 4. (auth)

4669 THE DISCOVERY OF AN INTERNAL RADIATION BELT AT AN ALTITUDE OF 320 KM IN THE REGION OF THE SOUTH ATLANTIC, MAGNETIC ANOMALY. S. N. Vernov, I. A. Savenko, P. I. Shavrin, and N. F. Pisarenko (Moscow State Univ.). Doklady Akad. Nauk S.S.S.R., 140: 1041-4(Oct. 11, 1961). (In Russian)

There is a wide region in South America and the South Atlantic, where anomalously low values of the earth's magnetic field occur. Data from a gas-filled counter and a NaI scintillation counter aboard the second large sputnik showed an increase in count rate in the anomalous region which can be explained only by the occurrence of an internal radiation belt. Outside the anomalous region the count rate increases by a factor of 3 to 4 in going from the equator to polar latitudes because of the variation in cosmic ray count with latitude. The count rate of the gas-filled counter is 15 to 25% of the count rate of the scintillation counter at all magnetic latitudes (N_2/N_1 = 15 to 25%). In the region of small magnetic latitudes (<20°) the count rate in the anomalous region rises, but N_2/N_1 = 20%. This increase in count rate is due principally to protons. With increasing magnetic latitude the scintillation count rate N_1 increases sharply, while the count rate of the gas-filled tube decreases on the average. The ratio N_2/N_1 falls to 1.6%. Bremsstrahlung radiation from the electrons of an internal radiation belt account for the increase in scintillation count rate in the anomalous region more than 20° south of the magnetic latitude. No sharp line of demarcation between the internal and external radiation belts could be detected in the region of the Brazilian anomaly. (TTT)

4670 DIURNAL VARIATION AND FORBUSH DECREASE. D. Cattani, M. Galli, and P. Randi (Università, Bologna). Nuovo cimento (10), 21: 923-34(Sept. 16, 1961). (In English)

Depressions preceding Forbush decreases by less than 24 h and features of a Forbush decrease such as the rarity of onsets during morning hours, the greater amplitude during the evening, as well as the small increases that sometimes happen during the main decrease, are discussed. The Forbush decrease is always associated with a train of diurnal variations and a train of diurnal variations often contains a more or less evident Forbush-type decrease. Through an analysis of the energy dependence of the above pre-decreases, and of a separation of local variations from world-wide variations in a Forbush decrease, it is shown that the forementioned characteristics associated with a decrease, are due to the superposition of diurnal variations to the world-wide Forbush decrease. The train of diurnal variations, with the Forbush effect removed, has a variable length that apparently does not exceed about ten days; it is reinforced and anticipated in phase during a period of two or three days containing the onset of the Forbush storm. (auth)

4671 INTENSITY OF THE COSMIC RADIATION AT GREAT DEPTHS UNDERGROUND. J. C. Barton (Northern Polytechnic, London). Phil. Mag. (8), 6: 1271-83(Oct. 1961).

The cosmic ray intensity was measured in a mine using a combined scintillation counter and Geiger counter telescope. It was shown that this apparatus could discriminate effectively against local γ-radiation. The intensities at 1660 and 3280 meters water equivalent were 3×10^{-5} and 10^{-6} of that at the surface; no cosmic ray events were observed at 5050 meters water equivalent. The results suggest a steepening of the energy spectrum in the region of 10^{12} ev. The most probable energy loss of μ-mesons which had a mean energy of about 3×10^{11} ev was found to be not significantly higher than that of minimum ionizing particles. (auth)

4672 ELECTROMAGNETIC RADIATION FROM SOLAR CORPUSCULAR STREAMS. M. A. Gintsburg (Inst. of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation, Academy of Sciences, Moscow). Phys. Rev. Letters, 7: 399-401(Dec. 1, 1961).

Objections to conclusions obtained in previous studies (J. MacArthur, Phys. Rev. Letters 2, 491(1959)) of cyclotron radiation from solar corpuscular streams moving in the earth's plasma are expressed. Radiation for superlight motion (when $u > v_f$) is studied, whereas previous studies were limited to sublight motion (in which the velocity u is less than $V_f = \omega/K$, the phase velocity of emitted waves. Studies are confined to the linear approximation in n^1/n, in which n and n^1 are, respectively, the plasma and the stream density. (L.N.N.)

4673 KNOCK-ON ELECTRONS AND DIRECT ELECTRON PAIR PRODUCTION BY COSMIC-RAY MUONS. P. H. Stoker, C. Hofmeyr, and C. H. Bornman (Potchefstroom Univ., South Africa). Proc. Phys. Soc. (London), 78: 650-60(Nov. 1, 1961).

Knock-on electrons and direct electron pair creation by

cosmic ray muons in thin lead plates were investigated with a multiplate cloud chamber. The muons traversing the cloud chamber were classified into two energy intervals, 450 to 1700 Mev and higher than 1700 Mev. By comparing the experimental results with theoretical predictions which were derived for the knock-on process, an effective range-energy relationship was found for electrons in lead with energies up to about 200 Mev. The experimental distributions of the knock-on production as a function of the energy transfer compare well with theoretical distributions calculated from Bhabha's formula for muons in both of these energy ranges. The comparison between the theoretical and experimental results is also satisfactory for the energy distribution for direct pair production by muons with energy above 1700 Mev. The theoretical distribution was calculated from a formula deduced anew from the differential cross section. The experimental results favor a value between 1 and 2 for the indefinite constant α of the theory. (auth)

4674 ABSORPTION OF NUCLEAR-ACTIVE COSMIC RAY PARTICLES IN AIR. G. Bozoki, E. Fen'ves, T. Sandor, O. Balea, M. Batagui, E. Friedlender, B. Betev, St. Kavlakov, and L. Mitrani. Zhur. Eksptl'. i Teoret. Fiz., 41: 1043-5(Oct. 1961). (In Russian)

Absorption of nuclear-active cosmic ray particles in air was studied by the coincidence method at altitudes of 80, 410, 950, and 2925 m above sea level. The μ-meson background was determined by measuring the underground flux. The absorption mean free path for nuclear-active particles in air is found to be $\lambda_a = (119 \pm 1)$ g/cm^2. The mean energy of the investigated nuclear-active particles estimated from the magnitude of their flux is ~30 Bev. (auth)

4675 ON CALCULATION OF THE FRACTION OF HIGH ENERGY ELECTRONS AND PHOTONS NEAR THE AXIS OF A BROAD ATMOSPHERIC SHOWER. I. V. Rakobolskaya. Zhur. Eksptl'. i Teoret. Fiz., 41: 1125-9(Oct. 1961). (In Russian)

The fraction of high energy electrons and photons of an extensive atmospheric shower, located at up to 3 meters from the shower axis, is computed under the assumption that π^0-mesons are generated continuously throughout the atmosphere. The angles of emission of the π^0-mesons are taken into account. It is shown that the theoretical calculations can be made consistent with the experimental results if, besides taking into account the π^0-meson emission angles, it is assumed that the energy spectrum of the photons produced is much softer than the spectrum of the nuclear-active component in the shower at energies $\geq 10^{11}$ to 10^{12} ev. (auth)

Criticality Studies

4676 (CEND-104) STUDY OF SLIGHTLY-ENRICHED URANIUM–WATER LATTICES WITH HIGH CONVERSION RATIO. RESONANCE ABSORPTION IN WATER MODERATED LATTICES. Quarterly Progress Report, February 1 to April 30, 1960. D. W. Drawbaugh (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Changed from OFFICIAL USE ONLY June 23, 1961. Contract AT(30-1)-2379. 82p.

A review is given of progress in recent years on the problem of calculating the resonance escape probability from the resonance parameters. A computer program (QUERY) for applying the Adler-Hinman-Nordheim method of calculating resonance escape in a lattice is also reviewed and applied to a series of calculations of integrals for U–water, and UO_2–water systems at various fuel temperatures. The results are compared with those obtained in Monte Carlo calculations for a variety of lattices at room temperature. Monte Carlo calculations at elevated temperatures were also made for comparison. Comparisons were also attempted for resonance escape calculations with experimental measurements of ratios of epithermal-to-thermal capture in U^{238} in various lattices. Problems involved in making such comparisons when enriched fuel elements are involved are discussed. (J.R.D.)

4677 (CRRP-985-B) EXPERIMENTAL EFFECTIVE FISSION CROSS SECTIONS AND NEUTRON SPECTRA IN A URANIUM FUEL ROD. PART II. CANDU-TYPE URANIUM OXIDE CLUSTERS. C. B. Bigham, B. G. Chidley, and R. B. Turner (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 124p. (AECL-1350)

Integral activation measurements were made in a CANDU-type 19-element UO_2 fuel cluster in which the heavy water or air in the coolant channels could be raised to ~280°C. The changes in effective neutron temperature, T, associated with coolant and fuel temperature changes were obtained from the values of $\sigma_f Pu^{239}/\sigma_f U^{235}$ and of $\sigma_c Lu^{176}/\sigma_c Mn^{55}$ relative to the values in a known spectrum. The epithermal index, r, was obtained from In^{115} resonance activation. Gold, tungsten, and molybdenum were used to measure higher energy slowing down flux distributions. The values of T for CANDU conditions were 145 and 174°C respectively for the two methods. The increase in T caused by the UO_2 was significant and about equal to that caused by the heavy water coolant. Large distortions were observed in the slowing down spectrum, in good agreement with calculated flux depression factors. The presence of the heavy water coolant did not have a very large effect on these distortions. (auth)

4678 (DP-640) PDP MEASUREMENTS ON NATURAL URANIUM FUEL TUBES IN D_2O. Norman P. Baumann (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 30p.

Buckling measurements were made in the Process Development Pile (PDP) in D_2O-moderated lattices of tubular natural uranium fuel assemblies, placed at a triangular pitch of 7 inches. The assembly types studied included four sets of single fuel tubes and six sets of double tubes. Bucklings were determined by an analysis of the critical water heights obtained when seven test assemblies were inserted into the central test region of the PDP. The effects of removing the central fuel assemblies and of replacing them by varying numbers of poison rods were also studied. Foil activation measurements of the lattice parameters f, L^2, p, and ϵ were made at the 7-inch pitch and, in two cases, at a pitch of 14 inches. The experimental results were compared with calculations. (auth)

4679 (HW-70944) NEUTRON MULTIPLICATION MEASUREMENT WITH Pu–Al ALLOY RODS IN LIGHT WATER. V. I. Neeley, R. C. Lloyd, and E. D. Clayton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 29, 1961. Contract AT(45-1)-1350. 12p.

Neutron multiplication and exponential measurements were conducted with Pu–Al alloy fuel elements in light water moderated lattices; a hexagonal pattern was used for the lattices which were fully water reflected. The critical mass was determined for 24-inch high cylinders by neutron multiplication measurements. The extrapolation length and bucklings for the lattices were determined by equating the buckling expression from the exponential measurements to the buckling expression for the critical size as determined from the neutron multiplication meas-

urements. These equations were then solved for the extrapolation length and buckling. The critical mass for spherical geometry was calculated from the measured buckling and extrapolation length. The minimum critical mass for the Al−5 wt % Pu alloy rods in light water was 1.5 kg plutonium. The maximum buckling was $11,300 \times 10^{-6}$ cm^{-2}. The effect on the critical mass of the Pu^{240} (~5%) was determined from calculations; the results indicate the critical mass (including all isotopes) would be reduced by about 8.2% in the absence of Pu^{240}, or to 1.38 kg Pu^{239}. A curve of the critical mass and buckling obtained from these experiments is shown. The various data are tabulated. (auth)

4680 (LAMS-2543) SIX AND SIXTEEN GROUP CROSS SECTIONS FOR FAST AND INTERMEDIATE CRITICAL ASSEMBLIES. Gordon E. Hansen and William H. Roach (Los Alamos Scientific Lab., N. Mex.). Nov. 1961. Contract W-7405-Eng-36. 72p.

Six-group neutron cross sections are listed for the more common fissionable isotopes for study of fast neutron critical assemblies and sixteen group cross sections of the more common reactor material for study of intermediate neutron critical assemblies. Data sources and averaging scheme used for the development of these multigroup parameters are also given. (auth)

4681 (NAA-SR-Memo-6587) CRITICALITY STUDY FOR POPR CRITICAL EXPERIMENT FUEL FABRICATION. N. Ketzlach (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 17, 1961. Contract [AT(11-1)-Gen-8]. 21p.

Nuclear safety criteria were established for the fabrication, storage, and transportation of UO_2 fuels having an enrichment of 2.0 and 3.0% U^{235}. Twelve figures are included summarizing the results of this study. The following criteria were established for the 3.0% U^{235} enriched fuel and may be safely applied to the 2.5% U^{235} enriched UO_2 fuel of interest. The maximum safe batch size of UO_2, independent of container size or degree of water flooding is 1.22 kgm contained U^{235}. Safe batch sizes as a function of container volume are also presented. The maximum safe geometries are 27 liters for the sphere volume, 9.75 inches for the infinite cylinder diameter, and 4.18 inches for the infinite slab thickness. The maximum safe numbers of rods, independent of container size or degree of water flooding, are 145, 110, and 90 for 0.30-inch, 0.34-inch, and 0.38 inch diameter rods, respectively. Safe criteria are also given for the spacing between batches of pellets or rods. Safe criteria were also established for the 2.0% U^{235} enriched UO_2. The maximum safe batch size, independent of container size or degree of water flooding is 1.99 kgm contained U^{235}. Safe batch sizes as a function of container volume are also presented. The maximum safe geometries are 52 liters for the sphere volume, 12.5 inches for the infinite cylinder diameter, and 5.95 inches for the infinite slab thickness. The maximum safe numbers of rods, independent of container size or degree of water flooding, are 290, 230, and 180 for 0.30-inch, 0.34-inch, and 0.38-inch diameter rods, respectively. Safe criteria are also given for the spacing between batches of pellets or rods. (auth)

Elementary Particles and Radiations

Refer also to abstract 4613.

4682 (AD-257306) APPLICATION OF DISTRIBUTIONS TO THE STUDY OF ELEMENTARY PARTICLES IN RELATIVISTIC QUANTUM MECHANICS. Technical Report No. 7. Laurent Schwartz. (California. Univ., Berkeley. Dept. of Mathematics). Mar. 1961. Contract Nonr 222 (60). 212p.

The notes to the lectures on the study of elementary particles in relativistic quantum mechanics are given: position of the problem, the set $||=||$ of the universal particles and its structure; universal particles and the translation invariance, kernel simplification; elementary particles and the rotation invariance, support of $F(H_0)$; elementary particles and the properties relative to $\vec{F}$; and definitions of some physical motions. (B.O.G.)

4683 (AFOSR-655) THE LOW ENERGY PION-PION INTERACTION. [PART] I. Technical Note No. 23. J. G. Taylor (Paris. Université, Orsay. École Normale Supérieure. Laboratoire de Physique Théorique et Hautes Energies and Institut des Hautes Études Scientifiques, Paris). Jan. 1961. Contract AF61(052)-173. 25p. (AD-258324)

A derivation is presented of the pion-pion amplitude from the properties of analyticity, unitarity, and crossing symmetry, CAU, which does not presuppose the Frazer-Fulco resonance, or use the N/D method, because of the ambiguity in the high-energy behavior of N and D separately. The inverse amplitude is used to derive the most general form of $\pi-\pi$ amplitude satisfying CAU. Explicit results are given for the assumptions that only S and P waves are important in all absorptive parts, and that inelastic processes are dominant at high energies. (B.O.G.)

4684 (AFOSR-1579) A PHENOMOLOGICAL APPROACH TO THE ELECTRODISINTEGRATION OF THE DEUTERON. Technical Note No. 50. B. Bosco (Stanford Univ., Calif. Inst. of Theoretical Physics). Oct. 1961. Contract AF49(638)-388. 22p.

A phenomenological analysis was made of experiments of Kendall, et. al., of the electrodisintegration of the deuteron for low-energy neutrons and protons in the c.m. system, and high four-momentum transfers. The analysis is based on the analytical properties of the transition matrix elements. The study is restricted to the s-waves, since the non-s-wave part is only a few percent of the cross section. (B.O.G.)

4685 (CERN-61-27) SOME STATISTICAL THEORY RESULTS ON π^* AND π^{**} PRODUCTION IN P-D COLLISIONS AROUND 2.3 GEV/C P-MOMENTUM. K. H. Michel (European Organization for Nuclear Research, Geneva). Nov. 24, 1961. 13p.

Calculations according to the statistical theory were carried out for the following reactions: $p + d \rightarrow T + n\pi$, $p + d \rightarrow T + \pi^* + n\pi$, and $p + d \rightarrow T + \pi^{**} + n\pi$. Three series of calculations were carried out for different energies of the incoming proton. For each of the different end states the non-normalized probability of the reaction was obtained. (M.C.G.)

4686 (CERN-61-28) THE INVERSE PHOTOPRODUCTION REACTION $\pi^- + p \rightarrow \gamma + n$. G. Gatti, P. Hillman, W. C. Middelkoop, T. Yamagata, and E. Zavattini (European Organization for Nuclear Research, Geneva). Oct. 11, 1961. 35p.

A measurement has been made of the inverse photoproduction reaction $\pi^- + p \rightarrow \gamma + n$ with 72 Mev pions and at 90° c.m. The differential cross-section is $(70 \pm 7)10^{-30}$ cm^2 $ster^{-1}$. Detailed balance and published measurements on the reaction $\gamma + p \rightarrow \pi^+ + n$ gave a π^-/π^+ ratio of 1.34 ± 0.15 at a proton energy of 182 Mev (c.m.) and at a c.m. angle of 90°. The technique used was coincidence detection of both particles with time-of-flight measurement of

the neutron energy to separate the reaction from the much more probable charge exchange reaction $\pi^- + p \rightarrow \pi^0 + n$. (auth)

4687 (D1-82-0063) MOTION OF AN IMPURITY PARTICLE IN A BOSON SUPERFLUID. Report No. 33. M. Girardeau (Boeing Scientific Research Labs., Seattle and Brandeis Univ., Waltham, Mass.). Sept. 1960. 65p.

The low-lying spectrum of a system of many bosons and one impurity particle interacting by repulsive central two-body forces is treated, by first eliminating the dynamical variables of the impurity in terms of an added effective boson-boson interaction, and then treating the boson system by an extension of Bogolubov's method. In this way various physical properties of the clothed impurity particle, including its dispersion relation and effective mass, are obtained. Singularities associated with the onset of acoustical wave drag as the impurity speed reaches the speed of sound in the boson medium are predicted. The parameters measuring the smallness of the corrections to the above results are shown to be the dimensionless boson-boson interaction, the dimensionless boson-impurity interaction, and the boson-impurity mass ratio. The treatment may be adapted to the case of hard spheres at low density, by employing the Huang-Yang-Lee pseudopotential method; the results are valid if the dimensionless boson density and the boson-impurity mass ratio are small. (auth)

4688 (D1-82-0115) VARIATIONAL METHOD FOR THE QUANTUM STATISTICS OF INTERACTING PARTICLES. Report No. 42. M. Girardeau (Boeing Scientific Research Labs., Seattle). June 1961. 37p.

This supersedes Boeing Document D1-82-0080, which had the same title.

A variational method was developed for calculating the thermodynamic potential of quantum-mechanical many-body systems with pair-wise interactions. The method was based on Peierls' theorem and yielded an upper bound to the thermodynamic potential density in the limit of an infinite system. Evaluation and minimization of the bound involved solution of a set of coupled nonlinear integral equations for the distribution function of elementary excitations and for functions defining a unitary transformation from bare particles to elementary excitations. Application of the theory to the BCS model of superconductivity reproduces the BCS results, and application to a degenerate imperfect Bose gas gave equations which are shown to be equivalent to those of Tolmachev and Wentzel. (auth)

4689 (JINR-P-765) RASSEYANIE P^--MEZONOV S ENERGIEI 7-8 BEV NA NUKLONAKH S BOLYSHOI PEREDACHEI IMPUL'SA. (Scattering of π^--Mesons with an Energy of 7-8 Bev on Nucleons with a Large Momentum Transfer). R. R. Aripov, V. G. Grishin, L. V. Sil'vestrov, and V. N. Strel'tsov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1961. 5p.

The upper limit for the π^--nucleon interaction cross section at 7 to 8 Bev is estimated for the case in which a large momentum transfer is observed. (auth)

4690 (NP-10773) RECUPERATION DES MESONS μ ET DES NEUTRINOS PRODUITS LE LONG D'UN CANAL DE LENTILLES MAGNETIQUES QUADRUPOLAIRES PAR DESINTEGRATION DE MESONS π. Rapport interne No. 612. (Recovery of μ Mesons and Neutrinos Produced Along Channels of Magnetic Quadrupole Lenses by Disintegration of π Mesons. Internal Report No. 612). Jean Fronteau (College de France, Paris. Laboratoire de Physique Atomique et Moleculaire). Apr. 1961. 20p.

The computer programs used for the calculation of the collection of μ mesons and neutrinos produced along channels of magnetic quadrupole lenses from π meson decay are discussed. The general problem is first discussed before two calculation rates are defined. (J.S.R.)

4691 (TID-13768) SCATTERING OF LOW ENERGY K^--MESONS BY NUCLEI. J. H. Hetherington and D. G. Ravenhall (Illinois. Univ., Urbana). [1961]. Contract [AT(11-1)-182]. 11p.

Results are presented of calculations linking the low-energy K^--proton scattering amplitudes with the optical potential for K^- mesons in nuclei. A comparison is made of the predicted K^--nucleus scattering with the appropriate low-energy emulsion data, from which the (a–) zero-range solution of Dalitz and Tuan appears to be a significantly poorer fit than the (a+) and (b+) solutions. The present results are considered not to favor the (b–) solution either, but they are less reliable in this case. (B.O.G.)

4692 (TID-13955) THE INELASTIC SCATTERING OF MESONS AND BARYONS (thesis). Michael Nauenberg (Cornell Univ., Ithaca, N. Y.). Feb. 1960. Contracts [AT(30-1)-2179] and Nonr 401-(12). 45p. (AD-255143)

An approximate expression near any threshold energy for the partial amplitudes of total angular momentum $j = \frac{1}{2}$ is derived in terms of a real, symmetric, and constant matrix. Proper Lorentz and reflection invariance is used to obtain the general form of the relativistic scattering matrix of a meson and a baryon. Both the cases where the incident and outgoing meson-baryon pair have the same and opposite intrinsic parity are considered. The scattering amplitude in the complete set of total angular momentum states is expanded in the center-of-mass frame of reference. The extension of the condition of unitarity to unphysical energies is briefly discussed. The Mandelstam representation is used to derive the analytic properties of the partial amplitudes in a complex variable S, which corresponds to the square of total energy for positive values. These partial amplitudes are shown to satisfy a dispersion relation, which becomes a nonlinear integral equation when unitarity is taken into account. The approximate solution near threshold energies corresponds to the so-called scattering length matrix. The following processes are considered as examples: $\pi + Y \rightarrow \pi + Y$, $\overline{K} + N \rightleftharpoons \pi + Y$, and $\overline{K} + N \rightarrow \overline{K} + N$. (D.L.C.)

4693 (TID-13960) RADIATION EFFECT OF POSITIVE ION BOMBARDMENT. Progress Report [for period] June 15, 1961 to September 15, 1961. R. L. Hines (Northwestern Univ., Evanston, Ill.). Oct. 20, 1961. Contract AT(11-1)-1053. 5p.

A summary is presented of work done in the determination of D_2^+ ion ranges in aluminum. The general procedure consists of bombarding a polished quartz surface covered with a known thickness of aluminum, and measuring the radiation damage layer of quartz caused by the ions penetrating the aluminum. The damage is found by measuring the reflection coefficient of the quartz at several wavelengths. The ranges of the D_2^+ ions in aluminum determined to date at 15 to 33.6 kev are 990 to 2020Å. (B.O.G.)

4694 (TID-14137) K^- ABSORPTION AND THE Y_0. R. L. Schult (Illinois. Univ., Urbana) and R. H. Capps (Northwestern Univ., Evanston, Ill.). [1961]. Contract [AT(11-1)-182]. 21p.

A simplification is given of the previously proposed relationship between a pion-hyperon resonance and the discrepancy in the K^--H and K^--D absorption data. The K^--helium data are shown to give supporting evidence to the resonance proposal. The recently discovered Y_0^* may be

the resonance in question. It is shown that in the zero range model, the real part of the isotopic spin zero scattering length must be less than −1.3 fermi in order to explain the hydrogen−deuterium discrepancy. (auth)

4695 (UCRL-8030(Rev.)) DATA FOR ELEMENTARY-PARTICLE PHYSICS. Walter H. Barkas and Arthur H. Rosenfeld (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1, 1961. Contract W-7405-eng-48. 30p.

Elementary-particle data and other reference information for use in high-energy physics are presented in tables and graphs. (M.C.G.)

4696 (UCRL-9835) PION-HYPERON RESONANCES (thesis). Stanley G. Wojcicki (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 24, 1961. Contract W-7405-Eng-48. 109p.

A study was made of 1.15-Bev/c K^--meson interactions in the Berkeley 15-in. hydrogen bubble chamber. The discussion is limited to some 600 events in which the final state consists of a Σ-hyperon and one or more pions. The mechanics of analysis with the PANG, KICK, and EXAMIN programs are described. A detailed discussion is given of the treatment of ambiguities between the various hypotheses, a problem that becomes quite severe at this energy. The discussion of results emphasizes the effect of strong final-state interactions in the Σ-π system. The relationship of the data to the recently discovered Y_1^* resonance in the $\Lambda\pi^+\pi^-$ reaction is discussed, and it is shown that the Σ/Λ branching ratio of Y_1^* is less than 16%. Evidence is presented for the existence of a T = 0 resonance in the Σ-π system with a mass of about 1400 Mev. It is shown that $K^- + p \rightarrow \Sigma + \pi$ reactions at this energy seem to proceed almost entirely from the T = 0 initial state, which might be because the reactions are still dominated by the T = 0 resonance in the K^-p system at ~1 Bev/c. (auth)

4697 (FTD-TT-61-115) RADIATION OF A CHARGED PARTICLE IN A MEDIUM WITH A PERIODICALLY VARYING DENSITY. A. Ts. Amatuni and N. A. Korkhmazyan. Translated from Izvest. Akad. Nauk Armyan. S.S.R., Ser. Fiz.-Mat. Nauk, 13: No. 5, 55-64(1960). 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 20086.

4698 ANGULAR CORRELATION OF ELECTRON NEUTRINO IN FREE NEUTRON DECAY. V. V. Vladimirskii, V. K. Grigor'ev, V. A. Ergakov, D. P. Zharkov, and Yu. V. Trebukhovskii. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1121-3(Sept. 1961). (In Russian)

The energy spectrum of recoil protons measured by time-of-flight was studied for various angular correlation coefficients λ. A 12 channel time analyzer with a channel width of 0.125 μsec, measuring range of 1.5 to 3 μsec, and a time rate of 20 pulse/hour was used. Channels 1, 2, 11, and 12 recorded background coincidences. The results, developed by the method of least quadratics, show $\lambda = -1.12 \pm 0.04$. The statistical error was 0.02 and apparatus (0.03). Considering tensor and scalar interactions are absent, the magnitude λ is $R = \frac{|g_{T-T}|^2}{|g_\phi|^2} = 1.75^{+0.48}_{-0.33}$. (R.V.J.)

4699 BREMSSTRAHLUNG IN MUON-PROTON SCATTERING EXPERIMENTS. Jean-Marie Abillon and Paul Kessler (Collège de France, Paris). J. phys. radium, 22: 521-4(Aug.-Sept. 1961). (In French)

With respect to muon-proton scattering experiments in a region where the momentum transfer is several hundred Mev, the method of quasi-real processes was used to calculate the contribution of bremsstrahlung to the scattering cross section. The result has to be combined with the Schwinger correction, which includes both virtual radiative effects and emission of real photons with very low energy. One thus gets the total radiative correction as a function of initial energy of the muon, scattering angle, and resolution width for the final energy. A numerical application is given for an initial energy of 2 Bev and different values of the scattering angle and the resolution width. (auth)

4700 DE-POLARIZATION PARAMETER IN p-p SCATTERING AT 143 MeV. L. Bird, P. Christmas, A. E. Taylor, and E. Wood (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nuclear Phys., 27: 586-95 (1961). (In English)

Measurements are reported on the Wolfenstein D parameter in p-p scattering at 143 Mev in the angular range 30 to 90° (center-of-mass). A longitudinal magnetic field was used to precess the polarization vector of the incident beam, thus largely eliminating similar sources of systematic error to those possible in the method used for measuring the asymmetries in the previous Harwell and Harvard determinations of D. The results of this remeasurement agree with the previous ones at small angles and are intermediate between the Harvard and previous Harwell values at large angles. However, since the method used is less subject to systematic error, the present results should be regarded as superseding the previous Harwell values. (auth)

4701 DISTORTED WAVE EXPANSION FOR SCATTERING PROBLEMS. P. Swan (Univ. of Melbourne). Nuclear Phys., 27: 620-31(1961). (In English)

The properties of a distorted wave method for the scattering wave function $\psi_l(r)$ and phase-shift δ_l are examined. For $|\delta_l| < \frac{1}{2}\pi$, $\tan^{(1)}\delta_l$ reduced to a series whose leading term is the first Born approximation for $\tan\delta_l$, whereas at low energies an approximate form of the shape-independent formula is obtained. For weak potentials ($|\delta_l(k)| \leqq \pi$ for all k), the method is valid for all k, but for strong potentials the assured range of validity is $|\delta_l| < \frac{1}{2}\pi$, provided the energy is sufficiently high. The over-all accuracy is 2−3% for δ_l, using non-singular potentials. Potentials singular at r = 0 may give lower accuracy. Higher approximations in the form of series expansions for $\psi_l^{(n)}(r)$ and $\tan\delta_l^{(n)}$ are developed, which reduce in the limit $n \rightarrow \infty$ to the corresponding Born series, convergent for $|\delta_l| < \frac{1}{2}\pi$. However, the rate of convergence for small n is much better than for the Born expansions, particularly for potential strengths near the radius of convergence. The expansions are also convergent for weak potentials when $\pi \geqq |\delta_l| > \frac{1}{2}\pi$, whereas the Born series are not. It is concluded that $\psi_l^{(1)}(r)$ and $\tan^{(1)}\delta_l$ are approximate summations of the corresponding Born series for $|\delta_l| < \frac{1}{2}\pi$, and therefore include contributions from the Born expansions of all orders. The summations for $\psi_l^{(n)}(r)$ and $\tan\delta_l^{(n)}$ are also valid for weak potentials for $\pi \geqq |\delta_l| \geqq \frac{1}{2}\pi$, having the character of Born expansions in inverse powers. The method is illustrated on zero energy neutron-proton scattering. (auth)

4702 ESCAPE PROBABILITIES AND FLUXES OUTSIDE SELF-ABSORBING CYLINDRICAL SOURCES. E. W. Sidebotham (United Kingdom Atomic Energy Authority, Risley, Eng.). Nuclear Power, 6: No. 68, 70-4(Dec. 1961).

Many of the problems in nuclear physics involve parameters which depend upon the reactions occurring in cylindrical sources such as fuel elements. The source strength, however, in fuel elements is seldom uniform. Thus, the effect of increasing the source strength in a radial direction with particular attention to the buildup of gamma radiation in the fuel element is investigated. Ap-

proximations are described which reduce computer time and cost for the calculations involved. The reaction rates of any of the secondary reactions, such as heat generation, in the materials will depend upon the flux and the cross-section for the reaction. The expressions for flux in cylindrical sources and surrounding materials are also involved. (N.W.R.)

4703 A MODEL FOR NON-LEPTONIC WEAK INTERACTIONS. W. B. Zeleny (Univ. of Sydney). Nuovo cimento (10), 21: 958-65(Sept. 16, 1961). (In English)

The suggestion is made that the nonleptonic weak interaction may be completely dissimilar to the leptonic weak interaction. A simple model for the nonleptonic weak interaction is given, based on Pais' idea of a "parity clash," and constructed to give the $|\Delta T| = 1/2$ rule and the observed asymmetry parameters in pionic hyperon decays. (auth)

4704 SOME ANALYTIC PROPERTIES OF A DECAY AMPLITUDE WITH FINAL STATE INTERACTIONS. II. THE SINGLE-LOOP FOUR-POINT DIAGRAMS IN $K \rightarrow 3\pi$ DECAY. G. Barton (Brookhaven National Lab., Upton, N. Y.) and C. Kacser. Nuovo cimento (10), 21: 988-1000 (Sept. 16, 1961). (In English)

Analytic properties of the simplest single-loop Feynman diagrams whose contributions to $K \rightarrow 3\pi$ decay depend on both of the independent energy variables are investigated. This is done by replacing the two internal double pion lines by fictitious single lines of discrete rest masses λ_1 and λ_2 and integrating over λ_1 and λ_2 at the end of the calculation. The analytic properties of the actual amplitude are those of the fictitious amplitude in the limit as λ_1 and λ_2 independently tend to a value of two pion masses from above. The amplitude has complex singularities and does not satisfy a Mandelstam-type representation. However, a one dimensional dispersion representation with only real cuts does hold in one variable when the other variable is fixed at any real value. Brief comment is given on the change in the properties of the amplitude as the K-meson mass increases past the instability point. (auth)

4705 SOME PROPERTIES OF HIGH ANGULAR MOMENTUM PARTIAL WAVE SCATTERING AMPLITUDES. P. B. Jones (Oxford Univ.). Nuovo cimento (10), 21: 1012-19(Sept. 16, 1961). (In English)

The form of the amplitude at low energy is shown to determine $l-1$ moments of the function, in the partial-wave dispersion relation, which is the discontinuity across the unphysical branch cut. An inequality is given for the number of zeros in this function. The form of the moment sequence necessary to give a partial-wave scattering amplitude consistent with unitarity and the partial wave dispersion relations is investigated. It is suggested that the sequence must be such that the absorption is a slowly varying function of the impact parameter. (auth)

4706 COHERENT AND INCOHERENT NUCLEAR π^0 PHOTOPRODUCTION. S. M. Berman (CERN, Geneva). Nuovo cimento (10), 21: 1020-7(Sept. 16, 1961). (In English)

A simple treatment of neutral pion photoproduction in complex nuclei, using closure and neglecting nuclear absorption of the π^0, is considered in the region of small momentum transfer. In addition to the usual incoherent process in a nucleus, the fact that the nucleon on which the π^0 is produced does not change its charge gives rise to the possibility of a coherent addition of the production amplitude over the whole nucleus, provided the momentum transfer to the nucleon is not large compared to the inverse nuclear size. Because the spin independent part of the production amplitude which is responsible for the coherent process, has a $\sin\theta$ dependence (θ is the angle between pion and photon), the coherent cross-section will vanish in the forward direction and will reach a maximum at an angle $\theta_m = (1.87)[Kr_0A^{1/3}]^{-1}$, where K is the photon momentum and $r_0A^{1/3}$ the charge radius of the nucleus. Due to the fact that the maximum does not occur at zero angle the ratios of the coherent cross-section at θ_m will behave as $A^{4/3}$ rather than A^2 in different elements. An estimate of the incoherent process is included and it is shown that this cross section is less than the sum of A free nucleons for small momentum transfers and reaches the free nucleon value as the momentum transfer approaches the Fermi momentum. (auth)

4707 OFF-SHELL PION-NUCLEON SCATTERING AND DISPERSION RELATIONS. E. Ferrari and F. Selleri (CERN, Geneva). Nuovo cimento (10), 21: 1028-44(Sept. 16, 1961). (In English)

The problem of pion-nucleon scattering when one of the pions is virtual is discussed. By assuming that one-dimensional dispersion relations in the energy variable can be written for suitably defined invariant amplitudes, and that also in the off-shell case the dispersive integrals are dominated by the $T = J = 3/2$ amplitude, an Omnès-type integral equation is deduced for this amplitude. The rigorous solution of this equation is discussed and reduced to an approximate simpler form which is more suitable for numerical calculations. This form is particularly simple for squared four-momenta of the virtual pion less than ~5 squared pion masses. (auth)

4708 LEPTONIC DECAY OF THE Λ^0-HYPERON. B. Bhowmik, D. P. Goyal, and N. K. Yamdagni (Univ. of Delhi). Nuovo cimento (10), 21: 1066-8(Sept. 16, 1961). (In English)

Two apparent cases of Λ^0 decay with e^- as a secondary are reported. An emulsion stack exposed to the magnetically separated K^- beam of the Berkeley Bevatron was scanned systematically for V events. Both V events consisted of only two outgoing tracks, that of a proton and an electron. No visible primary track could be associated with either of the V events. Results are presented in tabular form. Due to the high observed pB of electrons in each case, it is assumed that the events represent neutral-particle decay. Neutron decay is excluded on kinematical grounds; therefore, Λ^0 decay must take place in the mode: $\Lambda \rightarrow p + e^- + \bar{\nu}^-$, unless the decay of an unknown particle occurred. (L.N.N.)

4709 THE Y_0^{*0}, THE π'^0, AND THE BOUND STATE MODEL. S. Barshay and H. N. Pendleton (Brandeis Univ., Waltham, Mass.). Nuovo cimento (10), 21: 1069-72(Sept. 16, 1961). (In English)

Effects of an S-wave $\pi-\Lambda$ interaction strong enough to bind, thus forming a Σ, in the $\pi-\pi-\Lambda$ system are investigated. It is found that the bound state model is not immediately so useful as for the Σ. A "virtual" bound state, however, becomes useful, especially if a strong attractive force exists between the pions at low energies. Aspects of this possibility are discussed and results of calculations are represented graphically. (L.N.N.)

4710 REMARKS ON THE ANOMALY IN MESON PRODUCTION IN p + d COLLISIONS. L. Sertorio (Scuola di Perfezionamento in Fisica, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo cimento (10), 21: 1073-7 (Sept. 16, 1961). (In English)

Remarks are made on whether the anomaly can be explained by a threshold reaction of the two pions in an S state. Data were obtained at different incident energies. Inconclusive results were obtained. (L.N.N.)

4711 REMARKS ON THE "EFFECTIVE TARGET MASS." Z. Koba and A. Krzywicki (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Nuovo cimento (10), 21: 1078-83(Sept. 16, 1961). (In English)

Significance of the "target mass" is examined within the general kinematical framework of the Lorentz transformation and the energy-momentum conservation, and then applying the one-pion-exchange model with pole approximation. (L.N.N.)

4712 BARYON MASS DIFFERENCES AND ISOBAR STATES. N. Dallaporta (Università, Padova, Italy and Istituto Nazionale di Fisica Nucleare, Padova, Italy). Nuovo cimento (10), 21: 1084-93(Sept. 16, 1961). (In English)

Two of three different fundamental vector fields were postulated theoretically for isospin and baryon number conservation. The third, necessary for the complete gage invariant approach to strong interactions, is presented; experimental data are used in conjunction with theoretical arguments. Thus, possible connections of different experimental aspects reduce arbitrariness and the number of different assumptions necessary to explain the phenomenology of the strong interactions. (L.N.N.)

4713 INELASTIC FORM FACTORS. M. Gourdin (Faculté des Sciences, Orsay, France). Nuovo cimento (10), 21: 1094-9(Sept. 16, 1961). (In English)

Electron inelastic scattering by nucleons or nuclei in the process $e^- + A \rightarrow e^- + B + C$ is related to the photonuclear reaction $\gamma + A \rightarrow B + C$ by using first-order calculations in the electromagnetic coupling constant $\alpha = (e^2/4\pi) = (1/137)$. (L.N.N.)

4714 RESONANCE IN THE K–π SYSTEM. K. Igi and Y. Miyamoto (Tokyo Univ. of Education). Nuovo cimento (10), 21: 1100-2(Sept. 16, 1961). (In English)

Possibilities of identifying the $\overline{K}^0$ as K–π resonance are analyzed using methods explaining $\pi-\pi$ resonance (Y. Miyamoto, Progr. Theor. Phys. 24, 840(1960); G. F. Chew and S. Mandelstam, Nuovo Cimento 19, 752(1961)). The $\overline{K}^0$'s must be regarded as compound systems of heavy particles. If the $\overline{K}^0$ is considered as a bound state of K and an even number of pions, $\overline{K}^0 \rightarrow K + \pi$ is forbidden due to parity conservation. (L.N.N.)

4715 PARAMETRIC DISPERSION RELATIONS FOR ELECTRON FEYNMAN AMPLITUDES. P. Sen (National Physical Lab., New Delhi, India). Nuovo cimento (10), 21: 1103-5(Sept. 16, 1961). (In English)

By extending the manifestly covariant form of the Feynman notation to the mass coordinate and its Fourier transform, the proper time coordinate (J. Schwinger, Phys. Rev. 82, 664(1951)) and the Muraskin-Nishijima parametric dispersion relations (M. Muraskin and K. Nishijima, Phys. Rev. 112, 331(1961)) are derived explicitly and alternatively for the case of Dirac-Maxwell equations. An interpretation of the subtraction terms in a general field theory is also obtained. (L.N.N.)

4716 EVIDENCE FOR A THREE-PION RESONANCE NEAR 550 Mev. A. Pevsner (Johns Hopkins Univ., Baltimore), R. Kraemer, M. Nussbaum, C. Richardson, P. Schlein, R. Strand, T. Toohig, M. Block, A. Engler, R. Gessaroli, and C. Meltzer. Phys. Rev. Letters, 7: 421-3(Dec. 1, 1961).

Further data for a study of multipion resonances in $\pi^+ + d$ reactions observed in the Lawrence Radiation Laboratory 72-in. bubble chamber exposed to a 1.23 Bev/c pion beam from the Bevatron indicates the existence of a second neutral 3-pion resonance with a mass of ~550 Mev. The reaction $\pi^+ + d \rightarrow p + p + \pi^+ + \pi^- + \pi^0$ in which both protons are visible and at least one proton stops in the chamber with a range less than 15 cm, is considered. An ideogram for the first 199 events and a histogram for all 233 events are presented. An average mass uncertainty on a given event is ~ ± 20 Mev. A large peak near 770 Mev is the ω^0. Another large peak in the 3-pion mass plot is found near 550 Mev, which strongly suggests the existence of a second 3-pion resonance, the η. (L.N.N.)

4717 EXPERIMENTAL STUDY OF THE K^+_{e3} DECAY INTERACTION. John L. Brown (Univ. of California, Berkeley), John A. Kadyk, George H. Trilling, Remy T. Van de Walle, Byron P. Roe, and Daniel Sinclair. Phys. Rev. Letters, 7: 423-6(Dec. 1, 1961).

A study of K^+_{e3} decay events obtained in an exposure of the 21-liter xenon bubble chamber to a separated K^+ beam at the Bevatron was made. The decay made was identified by observing the large radiative energy loss of the charged secondary in the xenon. Both gamma rays from the π^0 convert into electron pairs in the xenon. A sample of 175 events was found. Distribution of the opening angle between the 2 decay gamma rays was studied. It was found that the data are consistent with the vector coupling hypothesis, but disagree for the tensor and scalar hypotheses when the scalar form factor is assumed to be slowly varying. (L.N.N.)

4718 NEW RESONANCES AND STRONG INTERACTION SYMMETRY. J. J. Sakurai (Univ. of Chicago). Phys. Rev. Letters, 7: 426-8(Dec. 1, 1961).

It is pointed out that in a class of theories which are sufficiently symmetric between N and Ξ, it is possible to forbid the $\pi\Sigma$ decay of Y_1^* and make the decay rate for $w^0 \rightarrow \pi^+ + \pi^- + \pi^0$ vanish to the extent that the N Ξ mass difference could be ignored. Other consequences of the symmetry postulated to be higher than that implied by charge independence are discussed. It is also shown that the postulated symmetry is a natural consequence of the vector theory of strong interactions provided that N and Ξ (together with Λ and/or Σ) are treated as fundamental baryons (not as in the Sakata model). (L.N.N.)

4719 PRODUCTION CROSS SECTION OF INTERMEDIATE BOSONS BY NEUTRINOS IN THE COULOMB FIELD OF PROTONS AND IRON. T. D. Lee (Inst. for Advanced Study, Princeton, N. J.), Peter Markstein, and C. N. Yang. Phys. Rev. Letters, 7: 429-33(Dec. 1, 1961).

Numerical computation of cross sections for $\nu' + Z \rightarrow W^+ + \mu^- + (Z$ in different states) and $\bar{\nu}' + Z \rightarrow W^- + \mu^+ (Z$ in different states) is reported where W is the proposed intermediate boson for weak interactions, ν' is the neutrino associated with the μ, and Z represents a target proton or nucleus. Both processes are shown to have the same cross section. (L.N.N.)

4720 THE THEORY OF THE "STRANGE" PARTICLE. H.-P. Duerr and W. Heisenberg (Max-Planck-Institut für Physik und Astrophysik, Munich). Z. Naturforsch., 16a: 726-47(Aug. 1961). (In German)

The strange particles can be represented within the framework of the nonlinear spinor theory by taking into account the degeneracy with respect to isospin and parity of the groundstate "vacuum". Use is made of the mathematical analogy between the theory of superconductivity and the theory of elementary particles, and in a first approximation a fourfold degeneracy of the groundstate is assumed. Each of the four states is considered as a mixture of states of similar symmetry. The Green functions of the type $\langle \Omega_\alpha | T X(x) \overline{X}(x') | \Omega_\beta \rangle$ are considered as invariant under the proper Lorentz-group, CPT and PG, applied on the field operators or the states $\Omega_\alpha\rangle$ separately; but as

invariant under isospin rotation, P or CT or G, only if the transformation is applied on the field-operators and the states Ω_α) simultaneously. Parity is represented in a manner discussed in an earlier paper by one of the authors. Only stationary states of strangeness 1 can be considered in this approximation. The fourfold degeneracy of the K meson is reduced to an additional symmetry which may be connected later with the existence of electromagnetic charge. The results of the calculations may be interpreted by describing the strange particles as composed of ordinary particles and a "spurion" taken from the groundstate "vacuum". The "spurion" carries an isospin 1/2 and a parity. The mass eigenvalues and the parity of the particles are calculated by means of a slightly inproved version of the Tamm-Dancoff method. The theoretical mass eigenvalues agree qualitatively with the observed masses. The calculated relative parities of the strange particles may later be checked by experiments. Besides the known particles of strangeness 1, the theory yields other eigenstates which are probably highly unstable since they could disintegrate into more stable particles by means of strong or electromagnetic interactions. (auth)

4721 THE ANNIHILATION OF POSITRONS IN FLIGHT. Peter Kilian (Universität, Gottingen, Ger.). Z. Physik, 164: 416-24(1961). (In German)

The differential cross section at 0° for annihilation in flight of positrons was measured with foils of lucite, Al, Cu, Ag, Sn, Au, and Pb. Positrons from Cu^{64} and Co^{56} with energies of 400, 600, 800, and 1000 kev were selected by means of a magnetic spectrometer of the Kofoed-Hansen type, and the annihilation was detected in a telescope consisting of three scintillation counters. The experimental results were compared with theoretical values computed from the two-quantum cross section by taking into account the effect of multiple scattering of the positrons. The agreement is good for light elements within a statistical accuracy of 10%. For heavy elements the experimental value was found to be 15% greater than the theoretical value which perhaps could be attributed to the one-quantum annihilation. (auth)

4722 FORM FACTOR OF THE π MESON AND STRUCTURE OF THE NUCLEONS. H. Salecker (Universität, Freiburgh i. B.). Z. Physik, 164: 463-82(1961). (In German)

Recent measurements of electron-proton scattering at Stanford have shown that the electric and magnetic form factors are not equal. Therefore, the isotopic vector parts of the form factors G_e^v and G_m^v are recalculated with unsubtracted dispersion relations in the 2π approximation. For the isotopic scalar parts we use $G_e^s(s) \approx G_e^v(s)$ and $G_m^s(s) \approx 0$ which is known to be valid for moderate energy-momentum transfer s. We obtain a simple closed expression for the electromagnetic form factor of the pion F_π in terms of the scattering length a_1 and the effective range r_1 of the π-π scattering in the state L = T = 1. a_1 is roughly known from pion production by pions. With this value and a suitable r_1, F has a resonance in the region of time-like energy-momentum transfer; and the pion rms radius becomes $\bar{r}_\pi^2 = (0.82 \times 10^{-13}\ \text{cm})^2$. The calculated anomalous magnetic moment, the electric and the magnetic rms radii of the proton are then within 10% of the experimental values, the electric charge within 30%. Moreover, the proton form factors are different from each other and up to an energy-momentum transfer of $s = (-q^2/m_\pi^2) = 23$ within the experimental error of the new measurements. The deviations for higher values of the energy-momentum transfer may be explained in terms of the isotopic scalar parts of the form factors. In this case the electric form factor of the neutron will be different from zero in that region and the magnetic form factor of proton and neutron will no longer be equal. For comparison with other experiments we also calculate the $\pi^+ - \pi^-$ cross section with neglect of other states than L = T = 1. Under this assumption the $\pi - \pi$ cross section has a resonance for low energy-momentum transfer. (auth)

4723 STUDY OF THREE- PRONG STARS PRODUCED IN NUCLEAR EMULSIONS AS A RESULT OF INELASTIC pn-INTERACTIONS AT 9 Bev. V. A. Botvin, Zh. S. Takibaev, I. Ya. Chasnikov, N. P. Pavlova, and E. G. Boos (Inst. of Nuclear Research, Academy of Sciences, Kazakh SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 993-1002(Oct. 1961). (In Russian)

Three-prong stars produced in nuclear emulsion in pn-interactions involving 9-Bev primary protons are analyzed. The proton and π-meson angular distributions, energy spectra, and transverse momentum distributions are studied. A detailed study of the magnitude of the asymmetry in the angular distributions is performed. Each type of reaction is analyzed separately and the mean fraction of energy carried off by a proton and a π-meson is found to be independent of the reaction type. A distribution in the true inelasticity coefficients K is given for the reaction $p + n \rightarrow p + p + \pi^- + {}^{\text{neutral particles}}$. A tendency to form two peaks is observed in the distribution in K and this may indicate the existence of two different mechanisms of multiple production of particles. (auth)

4724 ELASTIC SCATTERING OF 2.8-Bev/c π^- MESONS ON NEUTRONS. Yu. D. Bayukov, G. A. Leksin, and Ya. Ya. Shalamov (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1025-30(Oct. 1961). (In Russian)

The differential cross section for 2.8-Bev π^-n scattering are determined for angles from 10 to 180° in the cms. The probability for nondiffractional scattering of π^- mesons is small and sharply drops with growth of the incident meson energy. (auth)

4725 SPECTRUM OF ELECTRONS EMITTED IN THE DECAY OF NEGATIVE μ-MESONS IN A NUCLEAR EMULSION. A. O. Vaisenberg, E. A. Pesotskaya, and V. A. Smirnitskii. Zhur. Eksptl'. i Teoret. Fiz., 41: 1031-6(Oct. 1961). (In Russian)

The spectra of electrons produced in the decay of μ^- mesons captured by light (C, N, O) and heavy (Ag, Br) mesic atoms in a nuclear emulsion are measured. In the first case, the spectrum is identical to the positron spectrum from μ^+–e decays. In the second case, the spectrum shape seems to become softer. The spectrum of Auger electrons accompanying μ^-–e decays is obtained The probability for Auger electron formation in light mesic atoms is shown to agree with the theoretical predictions. (auth)

4726 INELASTIC INTERACTION OF PROTONS AND NUCLEONS AT AN ENERGY OF 9 Bev. T. Vishki, I. M. Gramenitskii, Z. Korbel, A. A. Nomofilov, M. J. Podgoretskii, L. Rob, V. N. Streltsov, D. Tuvdendorzh, and M. S. Khvastunov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1069-75(Oct. 1961). (In Russian)

The multiplicity dependence of the angular and energy characteristics of secondary particles in proton–nucleon encounters at an energy of 9 Bev is studied. A comparison is made with results of calculations based on the single-meson scheme. (auth)

4727 REMOVAL OF MULTIPLICITY IN PHASE SHIFT ANALYSIS. N. P. Klepikov (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1187-94(Oct. 1961). (In Russian)

It is demonstrated that the set of n equations of the phase shift analysis of the scattering of spin 0 and ½ particles with an unknown polarization and also each set of n equations from the 2n − 1 equations of the phase shift analysis of scattering of spinless particles possess (in a certain generalized sense) exactly 2^n solutions, including nonunitary ones. The "complete experiment," which includes 2n − 1 measurements, can be replaced in both cases by n + 1 measurements (the "necessary experiment"). (auth)

4728 A MODEL FOR ANOMALOUS MUON INTERACTION. I. Yu. Kobzarev and L. B. Okun (Inst. of Theoretical and Experimental Physics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1205-14(Oct. 1961). (In Russian)

A model is considered in which the muon and electron mass difference is caused by interaction of the muon with a hypothetical neutral vector meson χ. Possible manifestations of this interaction are discussed. The interaction of the muon neutrino and baryons with the χ-mesons is analyzed. (auth)

4729 THEORY OF REACTIONS INVOLVING THE FORMATION OF THREE PARTICLES NEAR THE THRESHOLD DECAY. V. N. Gribov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1221-30(Oct. 1961). (In Russian)

It is shown that for an arbitrary reaction involving the formation of three particles, the contribution from long range interaction proportional to pair interaction amplitudes can be separated and cannot be expanded into a series in superthreshold momenta. This permits determination of the scattering amplitude for unstable particles at zero energy by analyzing the reactions in which they are produced. The reactions $K^+ \to 2\pi^+ + \pi^-$, $2\pi^0 + \pi^+$ are considered in detail. (auth)

4730 KINETIC EQUATION FOR A DEGENERATE SYSTEM OF FERMI PARTICLES. G. M. Eliashberg (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1241-51(Oct. 1961). (In Russian)

A deduction of the kinetic equation for the excitation distribution function in a degenerate Fermi system is presented. It is based on application of the temperature diagram technique and the analytical continuation method. The properties of the four-vertex part are investigated and the equation for it is extended. The problem of applying the results to a microscopic theory of Fermi liquid is briefly discussed. (auth)

4731 ON THE ELECTROMAGNETIC STRUCTURE OF THE K-MESON. A. A. Startsev (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1252-3(Oct. 1961). (In Russian)

An expression for the isovector part of the K-meson electromagnetic form factor was deduced by applying the dispersion relations technique to the problem of the structure of the K-meson. The electromagnetic K-meson radius is calculated by assuming narrow $\pi\pi$-resonance. (auth)

4732 PHOTOPRODUCTION OF NEUTRINOS OF ELECTRONS AND THE NEUTRINO RADIATION FROM STARS. V. I. Ritus (Lebedev Inst. of Physics). Zhur. Eksptl'. i Teoret. Fiz., 41: 1285-93(Oct. 1961). (In Russian)

Photoproduction of a neutrino−antineutrino pair on an electron is considered. The cross section is calculated and in the nonrelativistic approximation, the power of the photoneutrino flux from a high density and high temperature electron gas (degenerate as well as nondegenerate) is determined. The power of the photoneutrino flux from an electron gas at a temperature $\kappa T \sim 40$ kev (κ is the Boltzmann constant) and density $\rho \sim 10^5$ g/cm^3 exceeds by two orders of magnitude the power of the neutrino bremsstrahlung radiation under the same conditions previously calculated. The energy density carried off by photoneutrino radiation in high temperature and high denty stars (such as Novae between bursts, etc.) is greater than the usual photon emittance. (auth)

4733 ON THE POSSIBILITY OF POLARIZATION OF AN ELECTRON BEAM DUE TO RELATIVISTIC RADIATION IN A MAGNETIC FIELD. I. M. Ternov, Yu. M. Loskutov, and L. I. Korovina (Moscow State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1294-5(Oct. 1961). (In Russian)

Spin flip of electrons due to radiation during movement in a uniform magnetic field is considered. It is demonstrated that an initially unpolarized beam becomes partially polarized, the magnetic moment mainly being directed along the field. (auth)

4734 ON THE $\bar{K} + N \to \Lambda(\Sigma) + \gamma$ PROCESS. L. I. Lapidus and Kuang-chao Chou (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1310-14(Oct. 1961). (In Russian)

Information on $\Lambda(\Sigma) + \pi \to \Lambda(\Sigma) + \gamma$ processes can be obtained by investigating the $\bar{K} + N \to \Lambda(\Sigma) + \gamma$ reaction. A detailed phenomenological analysis of these processes in the s-state is performed. The Kroll-Ruderman theorem for photoproduction of pions on hyperons near the threshold is considered. (auth)

4735 NUCLEAR RECOIL IN THE EQUIVALENT PHOTON METHOD. A. M. Badalyan. Zhur. Eksptl'. i Teoret. Fiz., 41: 1315-23(Oct. 1961). (In Russian)

The region of nuclear recoil in which the Weizsäcker-Williams relation is valid, is investigated by considering the bremsstrahlung of an electron in the nuclear field as an example. It is shown that the region of permissible values depends on whether the cross section is averaged over the directions of nuclear recoil, or not. It is also demonstrated that the Weizsäcker-Williams relation is violated in a narrow region corresponding to strictly forward emission by the electron. The treatment is of a completely covariant nature. (auth)

4736 SCATTERING OF π MESONS ON NUCLEONS AT 7 TO 8 Bev WITH LARGE PULSE TRANSMISSION. R. A. Aripov, V. G. Grishin, L. V. Sil'vestrov, and V. N. Strel'tsov (Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1330-1(Oct. 1961). (In Russian)

The following π-N backward scattering reactions were studied under laboratory conditions: $\pi^- + n \to \pi^- + n$, $\pi^- + p \to \pi^- + p$, and $\pi^- + p \to \pi^0 + n$. The work was carried out with a 24-liter propane bubble chamber placed in a 13,700 gauss magnetic field with a π^- beam of 7 to 8 Bev. The upper cross sections level for the first reaction was evaluated as: $\sigma_1(\geq 90°) \leq 0.06$ mb, for the second $\sigma_2(\geq 90°) \leq 0.02$ mb, and for the third $\sigma_3(\geq 90°) \lesssim 0.1$ mb. The reaction cross sections, especially the first and third, are considerably smaller than those previously calculated according to a diagram. This may be explained by compensating processes in the diagram. (R.V.J.)

4737 ELEMENTARY PARTICLES. A Short History of Some Discoveries in Atomic Physics. Chen Ning Yang.

The Vanuxem Lectures, 1959. Princeton, New Jersey, Princeton University Press, 1961. 71p. $2.75.

A brief review is presented of the knowledge of the components making up the atom and of the discoveries made in this field in the last 60 years. Emphasis is given on the interplay between the theoretical and experimental aspects of the subject. (D.L.C.)

4738 THE PHYSICAL BASIS OF POLARIZED EMISSION. P. P. Feofilov. Authorized Translation from the Russian. New York, Consultants Bureau, 1961. 284p. $12.50.

The problems associated with the emission of polarized electromagnetic radiation are analyzed as a means of studying the structure of the emitting system. Attention is devoted to the basic properties of radiation and radiation fields. A study is made of the multipolarity of emitters. The study of polarized emission includes, in order of increasing complexity, atomic resonance radiation and the emission spectra of atoms, diatomic molecules, complex molecules, and crystals. Methods of measuring polarization are also considered. (T.F.H.)

Neutron Physics

Refer also to abstract 4616.

4739 (ARF-1164-18) RESEARCH STUDY ON NEUTRON INTERACTIONS IN MATTER AS RELATED TO IMAGE FORMATION. First Technical Progress Report, July 1, 1961–September 30, 1961. H. V. Watts (Illinois Inst. of Tech., Chicago. Armour Research Foundation). Nov. 17, 1961. Contract AT(11-1)-578. 20p.

The image quality as a function of the parameters of neutron scattering and image detector resolution was studied using an optical technique which simulates the neutron intensity pattern at the image plane for a radiographic object containing both neutron absorption and scattering. Data were obtained for the effects of detector resolutions ranging from 2 to 100 mils on the images of an ideal absorption, an absorption edge followed by thick neutron scatterers, and a small absorption strip image. A large-area neutron beam exposure facility is briefly described. (D.L.C.)

4740 (ORNL-TM-73) ON THE REALITY OF THE EIGEN-VALUES FOR A ONE-GROUP N-REGION DIFFUSION PROBLEM. T. W. Hildebrandt (Oak Ridge National Lab., Tenn.). Dec. 5, 1961. Contract [W-7405-Eng-26]. 7p.

A sufficient condition is presented for the reality of the eigen-values for a fairly general one-group, multiregion two-dimensional diffusion problem. The condition is also sufficient to insure the orthogonality of eigen-functions corresponding to distinct eigen-values. (D.L.C.)

4741 (TID-14157) STUDIES RELATING TO SCATTERING OF NEUTRONS AND ALLIED PHENOMENA. Annual Progress Report for 1961. D. M. Van Patter (Bartol Research Foundation, Swarthmore, Penna.). 1961. Contract AT(30-1)-1679. 41p.

Experimental results for the $Cr(n,n'\gamma)$ and $Sr(n,n'\gamma)$ reactions are discussed. Considerable progress has been made in the theoretical calculations of (n,n') cross sections and $(n,n'\gamma)$ angular distributions for even-even nuclei. The polarization of 3.1-Mev neutrons elastically scattered at 90° from complex nuclei has been measured for eight elements. A study of the $Sr^{88}(p,n)Y^{88}$ reaction has been conducted to settle discrepancies in the $Zr^{88}-Y^{88}-Sr^{88}$ decay scheme. (auth)

4742 AN ANALYTICAL SOLUTION METHOD FOR THE ENERGY-DEPENDENT NEUTRON TRANSPORT PROBLEM. Hans Hejtmanek (Österreichische Hochschule, Vienna). Atomkernenergie, 6: 350-3(Sept. 1961). (In German)

This paper treats the energy dependent neutron transport problem for plane geometry. From first principles one gets the integral equation of this problem. This equation is solved using a Fourier-Mellin transform. (auth)

4743 ON THE EXACT THEORY OF THE SLOWING-DOWN OF NEUTRONS IN AN INFINITE HOMOGENEOUS MEDIUM. V. C. Boffi (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nuovo cimento (10), 21: 935-57(Sept. 16, 1961). (In English)

The stationary energy distribution of neutrons slowed down in an infinite homogeneous absorbing medium is discussed. In particular, by confining the discussion to the field of the real variable, the following two problems are considered: the existence, for any scattering and capture law, of a formally exact solution of the Boltzmann equation; the asymptotic behavior of this solution. By assuming a constant scattering cross-section, details are given for the three practical cases of slowing down: without capture, with constant capture and with 1/v-capture. For the last case, curves representing the exact solution evaluated numerically are shown. (auth)

4744 NONSTATIONARY ELASTIC SLOWING DOWN OF NEUTRONS IN GRAPHITE AND IRON. A. I. Isakov (Lebedev Inst. of Physics, Moscow). Zhur. Eksptl'. i Teoret. Fiz., 41: 1037-9(Oct. 1961). (In Russian)

The slowing-down time distribution was measured with a pulsed neutron source for neutrons slowed down from 14 to 4.9 Mev in graphite and iron. The results satisfactorily agree with the nonstationary theory of elastic slowing down of neutrons. The cross section for neutron capture in iron was also measured and found to be 2.57 ± 0.04 bn for E = 0.0253 ev. (auth)

4745 "METALLIC" REFLECTION OF NEUTRONS. I. I. Gurevich and P. E. Nemirovskii. Zhur. Eksptl'. i Teoret Fiz., 41: 1175-7(Oct. 1961). (In Russian)

Reflection of neutrons from strongly absorbing media is considered. A formula is derived for the reflection coefficient at vanishing neutron energies. The absorption cross section in the medium is shown to saturate at sufficiently small neutron energies. (auth)

4746 INTERFERENCE BETWEEN DIRECT AND RESONANCE CAPTURE OF SLOW NEUTRONS. I. Lovas (Central Scientific-Research Inst. of Physics, Budapest). Zhur. Eksptl'. i Teoret. Fiz., 41: 1178-84(Oct. 1961). (In Russian)

As is well known, the effective cross section for resonance capture of slow neutrons is symmetrical if a compound nucleus is formed. It is shown that the effective cross section is not symmetric if compound nucleus formation and direct capture occur simultaneously. (auth)

Nuclear Properties and Reactions

Refer also to abstracts 4612 and 4614.

4747 (AD-258119) RADIOACTIVE DECAY ASSOCIATED WITH PLATINUM 195 (thesis). Richard Then White (Ohio State Univ., Columbus). 1961. 36p.

A study was made of the gamma decay produced in Ir^{195} and Pt^{195} from the bombardment of Os^{192} by 24-Mev alpha particles. The results confirm the reaction $Os^{192}(\alpha,n)$

Pt^{195m}, and clearly suggest the concurrent production of Ir^{195} by an (α,p) reaction. Ir^{195} was found to decay by negatron emission at a half life of 4 hours. Beta particles of 1.1-Mev end-point energy represent transitions directly to the ground state of Pt^{195}. Transitions by emission of beta particles of less energy give rise to gamma rays at 380, 204, and 310 kev, the latter two being coincident. (B.O.G.)

4748 (AWRE-NR/P-2/61) THE SPIN CUT-OFF PARAMETER IN NUCLEAR LEVEL DENSITIES. N. MacDonald (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Nov. 1961. 20p.

Using a consistent choice of nuclear temperatures and radii, the available estimates of the parameter σ^2, which characterizes the rate at which the nuclear level density falls off with increasing spin, were compared. Comments are presented on the discrepancies between these estimates, and on the sources of error in the analysis of various kinds of experimental data to obtain σ^2. In particular the use of the classical treatment of angular distributions in compound nucleus reactions is criticized in certain cases. A discussion is given of the general features of the behavior of σ^2 expected theoretically, including shell effects. It was concluded that the present data do not give a sufficiently reliable basis for testing theoretical predictions. Certain specific cases are pointed out in which more information would be valuable. It was noted that even a reliable lower limit on σ^2, such as can be obtained from an accurately isotropic angular distribution in a compound nucleus reaction, is at present useful. (auth)

4749 (GA-2563) THE CONTRIBUTION OF THE INDIVIDUAL RESONANCES TO THE RESONANCE INTEGRALS IN URANIUM AND THORIUM. L. W. Nordheim (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 26, 1961. Contract AT(04-3)-167. 26p.

Information is presented in tabular form on the contributions of the individual resonances to the resonance integrals in U and Th. The cases considered are for isolated cylindrical rods and involve U^{238}, $U^{238}O_2$, Th^{232}, and $Th^{232}O_2$. (M.C.G.)

4750 (IA-642) SIXTEEN-GROUP CAPTURE CROSS SECTIONS OF PLUTONIUM-239 AND URANIUM-233. Shimon Yiftah (Israel. Atomic Energy Commission, Tel-Aviv). July 1961. 13p.

Capture-to-fission ratios were determined for U^{233}, U^{235}, and Pu^{239}. The cross sections were compared with previous measurements. Results are presented in graphs and tables. (M.C.G.)

4751 (JAERI-4019) GAMMA-RAY SPECTRA OF SHORT HALF-LIFE NUCLIDES. Y. Kamemoto, K. Shiba, M. Handa, and M. Okada (Japan Atomic Energy Research Inst., Tokyo). July 25, 1961. 25p.

Gamma spectrograms are presented for 29 nuclides having half lives of 1 to 330 sec. The nuclides are produced by neutron irradiation, and the spectra are measured with a well-type NaI(Tl) crystal. The data may be used in the application of γ spectrometry to neutron activation analysis. (auth)

4752 (NRL-5697) INELASTIC NEUTRON GAMMA ANGULAR CORRELATION FOR THE $C^{12}(n,n'\gamma)C^{12}$ REACTION. R. B. Theus, L. A. Beach, and A. H. Aitken (Naval Research Lab., Washington, D. C.). Aug. 17, 1961. 12p.

The azimuthal correlation of neutrons and gamma rays from 14-Mev neutrons inelastically scattered on C^{12} is measured. The resultant angular distribution is found to be isotropic for the inelastic neutrons and gamma rays scattered at right angles to the incident neutron beam. This distribution is compared with a plane-wave treatment of direct interaction theory and is found to be in disagreement. The theoretical angular dependency is dominated by a cos 4φ term for the assumption of either extreme L–S or j–j coupling for the nuclear wave function. (auth)

4753 (ORNL-3207) TABLE OF ELECTRONIC RADIAL FUNCTIONS AT THE NUCLEAR SURFACE AND TANGENTS OF PHASE SHIFTS. C. P. Bhalla and M. E. Rose (Oak Ridge National Lab., Tenn.). Dec. 21, 1961. Contract W-7405-eng-26. 390p.

Tables of electronic radial functions are presented. The finite nuclear size effects and the finite deBroglie wave length effects were incorporated in this work. A brief summary of the formulation of the problem is given. (M.C.G.)

4754 (PUC-1961-45) PICKUP REACTIONS INDUCED BY PROTONS INCIDENT ON SELECTED LIGHT NUCLEI (thesis). James C. Legg (Princeton Univ., N. J. Palmer Physical Lab.). Sept. 1961. Contract AT(30-1)-937. 102p.

A dE/dx, E counter telescope was used in conjunction with a pulse multiplier, to observe deuterons and some tritons from proton induced reactions in some selected light nuclei. The particle identification system was capable of presenting an essentially undistorted deuteron or triton spectrum in the presence of a much more intense background of protons of the same energy. Deuterons from $B^{11}(p,d)B^{10}$, $C^{14}(p,d)C^{13}$, $O^{16}(p,d)O^{15}$, and $O^{18}(p,d)O^{17}$ were observed. Also tritons leaving C^{12} and O^{16} in their ground states were observed from $C^{14}(p,t)C^{12}$ and $O^{18}(p,t)O^{16}$. The results of these observations are compared to results of similar experiments and to shell model predictions. Some evidence that the stripping single particle reduced width is more strongly dependent upon the binding energy of the transferred nucleon than previously suspected is noted. Comparison of the (p,t) results to those of the inverse (t,p) experiments done at different energies seems to indicate that this reaction may be treated by a reasonably simple stripping theory. (auth)

4755 (TID-13492) PHOTONUCLEAR ACTIVATION BY 20 MEV GAMMA RAYS. Technical Report No. 9. Walter DelBianco (Pennsylvania. Univ., Philadelphia). 1961. Contracts Nonr-551(17) and [AT(30-1)-2202]. 163p.

The photonuclear activation cross section of elements whose (γ,n) reaction leads to a suitable positron activity was measured using monochromatic gamma rays from $He^3(p,\gamma)He^4$ reaction. The gamma rays were monitored by a large sodium iodide crystal whose response curve to the γ rays was measured. The absorption coefficient of these photons in NaI was determined by a good geometry transmission experiment. The positron activity was determined by a coincidence detector, consisting of two 5 in. diameter by 2 in. long NaI crystals set on the annihilation radiation photopeaks. This detector was calibrated against a F^{18} positron source, standardized in a 2π flow counter. The $C^{12}(\gamma,n)C^{11}$ and $F^{19}(\gamma,n)F^{18}$ reactions were investigated over the energy range from 20.1 to 21.2 Mev. Structure, although reported by other experimenters, was not observed. The (γ,n) activation cross section was measured at 20.5 Mev for Cr^{50}, Fe^{54}, Cu^{63}, Zn^{64}, Mo^{92}, Sb^{121}, Pr^{141}, and the results compared with those obtained with betatron experiments. (auth)

4756 (FTD-TT-61-60) RADIOACTIVE PROPERTIES OF FISSION-FRAGMENT PREPARATIONS. A. G.

Bykov, P. V. Zimakov, and V. V. Kulichenko. Translated from Atomnaya Energ., 10: 362-7(Apr. 1961). 11p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 15, abstract no. 27951.

4757 THERMAL NEUTRON CROSS SECTIONS AND RESONANCE INTEGRALS OF THE REACTIONS $O^{17}(n,\alpha)C^{14}$, $Ar^{36}(n,\alpha)S^{33}$, AND $N^{14}(n,p)C^{14}$. G. C. Hanna, D. B. Primeau, and P. R. Tunnicliffe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 39: 1784-1806(Dec. 1961). (AECL-1378)

The thermal neutron cross sections of the exothermic reactions $O^{17}(n,\alpha)C^{14}$, $Ar^{36}(n,\alpha)S^{33}$, and $N^{14}(n,p)C^{14}$ were measured, relative to the activation cross section of gold, by using a pulse ionization chamber technique. The results obtained are 0.235 ± 0.005 barn, 5.52 ± 0.11 millibarns, and 1.83 ± 0.03 barns respectively. All the reactions were shown to have the same cadmium ratio as the $B^{10}(n,\alpha)Li^7$ reaction with accuracies of ±10%, ±40%, and ±3% respectively. The O^{17} result shows that capture in this nuclide contributes significantly to neutron absorption in heavy water. (auth)

4758 THE DECAY OF Er^{171}. A. Artna and M. W. Johns (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 39: 1817-32(Dec. 1961).

The decay of Er^{171} was studied using a magnetic beta spectrometer at a resolution of 0.5%. The energies and intensities of 30 transitions in Tm^{171} were established. The energies (Mev) and intensities (%) are as follows: 0.086 (~0.1), 0.1117 (68.8), 0.1166 (6.05), 0.1240 (20.5), 0.1664 (0.65), 0.2104 (0.67), 0.2364 (0.57), 0.2770 (0.74), 0.2956 (28.7), 0.3082 (64.4), 0.3712 (~0.4), 0.4040 (0.03), 0.4189 (0.09), 0.5437 (0.04), 0.5571 (0.08), 0.5727 (0.07), 0.6061 (0.10), 0.6187 (0.13), 0.6703 (0.30), 0.6753 (0.39), 0.7321 (0.18), 0.738 (0.06), 0.7835 (0.31), 0.7962 (0.80), 0.842 (0.04), 0.869 (0.06), 0.882 (0.07), 0.906 (0.88), 0.9105 (0.25), 0.962 (0.11). These transitions are interpreted in terms of 12 levels whose energies and spins are: 0 ($\frac{1}{2}$+), 0.0051 ($\frac{3}{2}$+), 0.1167 ($\frac{5}{2}$+), 0.1291 ($\frac{7}{2}$+), 0.4251 ($\frac{7}{2}$−), 0.5915 ($\frac{9}{2}$−), 0.6355 ($\frac{7}{2}$+), 0.675 ($\frac{3}{2}$+), 0.737 ($\frac{5}{2}$+), 0.912 ($\frac{5}{2}$+), 0.963 ($\frac{5}{2}$+), 0.997 ($\frac{7}{2}$+). The decay energy of Er^{171} is 1.490 ± 0.002 Mev. (auth)

4759 EXPLANATION BY A UHLENBECK-KONOPINSKI COUPLING OF THE ANOMALIES OF β^- AND β^+ SPECTRA. Charles Chahine and Bernard Jouvet. Compt. rend., 253: 945-7(Aug. 7, 1961). (In French)

In order to explain the Langer anomalies, the effect of an additional Uhlenbeck-Konopinski coupling on the β^- and β^+ spectra was studied. The anomalies established by Gamow-teller transitions can be accounted for by the additional coupling $K_A\bar{p}\gamma_\mu\gamma_5 N\bar{e}(1+\gamma_5)\partial_\mu\nu$ with $K_A/F_A < 0$, F_A being the Fermi constant of the axial coupling. (tr-auth)

4760 CROSS SECTION OF OXYGEN-16 FOR THE PRODUCTION OF CARBON-14 FOR HIGH ENERGY PROTONS. Murry A. Tamers and Georgette Delibrias. Compt. rend., 253: 1202-3(Sept. 11, 1961). (In French)

Water targets were irradiated between 0.05 and 2.7 Bev in order to determine the cross sections for the reaction $O^{16}(p,3p)C^{14}$. The measurements of C^{14} were made with the aid of a dating installation. The cross section values found are constant (2.3 ± 0.5 mb) and permit the prediction of measurable quantities of this isotope in stone meteorites. (tr-auth)

4761 EXCITATION FUNCTION OF THE NUCLEAR REACTION $^{238}U(p,3n)^{236}Np$ BETWEEN 30 AND 150 Mev. Marc Lefort (Laboratoire Joliot-Curie de Physique nucléaire, Faculte des Sciences, Paris). Compt. rend., 253, 2221-2(Nov. 13, 1961). (In French)

Pu^{236} formed by beta decay of Np^{236} was chemically isolated and the effective cross sections measured were compared to those calculated by the reaction (p,3n). The agreement was good while utilizing the hypothesis of fission-spallation competition. (tr-auth)

4762 ENERGY SPECTRA DURING THE PASSAGE OF BETA-RADIATION THROUGH MATTER. G. A. Volkov and G. R. Rik (Lenin All-Union Academy of Agricultural Science, Agrophysics Scientific Research Inst., [USSR]). Doklady Akad. Nauk S.S.S.R., 140: 1045-7(Oct. 11, 1961). (In Russian)

The energy distribution of beta radiation in an irradiated isotropic medium from a plane beta source is calculated by taking into account the scattering of the electrons, and also energy losses of the electrons by means of ionization and excitation of the atoms in the irradiated medium. Experimental data show that the energy distribution of the electrons $f(\eta)$ is given by the following: $f(\eta) = C\eta^\alpha(1-\eta)^2$, in which the constant α is different for various isotopes, and $0 < \alpha < 1$. The term η is the actual path traversed by the electron from the source to the point ξ in units of the maximum range of the electron in the given medium. It is found that the change in the number of particles $N(\xi)$ with distance can be expressed as: $\ln[N(\xi)/N(0)] = -A|\xi| + (1+\alpha)\ln(1-1|\xi|)$. This equation can be used to determine the constant A. A C^{14} source immersed in polystyrol is taken as an example. It is found that α is equal to 0.13 and A = 7.6. A plot of the energy spectra versus relative intensity at various penetration depths shows good agreement between theory and experiment. The theory was also used successfully for the adsorption of beta particles from S^{35} and Ca^{35} in polystyrol. (TTT)

4763 PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON POLARIZATION PHENOMENA OF NUCLEONS, BASEL, 4-8 JULY, 1960. P. Huber and K. P. Meyer, eds. Helv. Phys. Acta, Suppl. 6, 1-433(1961).

Fifty-one papers are presented from the symposium, on such topics as production of sources and targets of polarized nuclei, production of polarized nucleons and deuterons by reactions, reactions and scattering of polarized particles, and the theory of nucleonic polarization effects. Separate abstracts have been prepared for 40 of the 51 papers; 37 are in English, and 3 in French. Nine of the papers have been previously abstracted in NSA. The 2 papers not abstracted separately concern the neutron polarization in the reaction $Li^7(p,n)Be^7$, and nuclear polarization in direct nuclear reactions. (T.F.H.)

4764 SURVEY OF METHODS OF PRODUCING SOURCES OF POLARIZED PROTONS. W. Paul (Universität, Bonn and C.E.R.N., Geneva). Helv. Phys. Acta, Suppl. 6, 17-25(1961). (In English)

Polarized proton beams may be produced by the following sequence: polarization of neutral H atoms or H_2 molecules; ionization of the polarized particles; and acceleration of the polarized protons to the desired energy. Methods are surveyed in which this sequence is utilized. Techniques are described for polarizing 1S H, 2S H, and o-H_2. The problems of depolarization during ionization and acceleration are discussed. (T.F.H.)

4765 PRODUCTION OF POLARIZED PROTONS FROM A BEAM OF ATOMIC HYDROGEN BY QUADRUPOLE WEAK FIELD SEPARATION OF ONE HYPERFINE COMPONENT. R. Fleischmann (Institut für Physik, Erlangen, Ger.). Helv. Phys. Acta, Suppl. 6, 26-34(1961). (In English)

An apparatus is described in which atomic H is produced in a Wood's discharge, and is emitted through a de Laval

nozzle in order to achieve high intensity. The H beam is polarized by being passed through the field of a 4-pole magnet having a field gradient that varies uniformly from 40 to 15 kG/cm from the entrance to the exit. The polarized beam is then ionized to protons and accelerated. (T.F.H.)

4766 THE POLARIZED PROTON SOURCE FOR THE MINNESOTA LINEAR ACCELERATOR. G. Clausnitzer (Univ. of Minnesota, Minneapolis). Helv. Phys. Acta, Suppl. 6, 35-47(1961). (In English)

The complete vacuum system with all essential parts is assembled in the final location and is working. The ion current extracted from the ionizer is measured with a collector, because the source is not connected to the accelerating column of the 500 kv injector. The result is a corrected (for residual pressure change) current increase of about 100% when the beam shutter is opened. (auth)

4767 PRODUCTION OF POLARIZED PROTONS FROM A BEAM OF ATOMIC HYDROGEN BY QUADRUPOLE STRONG-TO-WEAK FIELD SEPARATION OF ONE HYPERFINE COMPONENT. R. Keller, L. Dick, and M. Fidecaro (C.E.R.N., Geneva). Helv. Phys. Acta, Suppl. 6, 48-58(1961). (In English)

The design of a polarized proton source for a 600-Mev synchrocyclotron (SC) is described. H is dissociated and ejected as a beam of atomic H through a de Laval nozzle into the central region of the SC. The beam then passes through a 1.4-m-long permanent quadrupole magnet, whose poles are shaped such that the field decreases uniformly from 3400 to 170 gauss in order to separate the 4 major hyperfine components. The desired hyperfine component is then ionized by electron bombardment and accelerated. (T.F.H.)

4768 THE POLARIZED PROTON SOURCE FOR THE HARWELL PROTON LINEAR ACCELERATOR. M. K. Craddock (Clarendon Lab., Oxford). Helv. Phys. Acta, Suppl. 6, 59-76(1961). (In English)

A polarized proton source with a p current rating over 0.1 μa is built. The polarization is not measured but 40% should be attainable. The most satisfactory points of this design seem to be the short, strong-field magnet, which gives good intensity; and the glass collimator, which reduces the pumping requirements to a tolerable level. The chief disadvantage is the situation of the source at a potential of 520 kv; however, this is outweighed by intensity considerations. The ionizer has an efficiency of less than 10^{-3}. (auth)

4769 THE PRODUCTION OF POLARIZED PARTICLES FROM AN ATOMIC BEAM BY QUADRUPOLE STRONG FIELD SEPARATION OF HYPERFINE COMPONENTS. L. Brown, E. Baumgartner, P. Huber, H. Rudin, and H. R. Striebel (Universität, Basel). Helv. Phys. Acta, Suppl. 6, 77-88(1961). (In English)

A device is constructed for the production of polarized deuterons from an atomic beam. The design of the source is described. The alignment of the 10^{-6} A deuteron beam is established by observing the anisotropy of neutron distribution from the $T(d,n)He^4$ reaction. Experiments indicate that the device may be useful as a source of polarized protons, if the proton content of the residual gas ions is reduced. (auth)

4770 STUDY OF A SOURCE OF POLARIZED PROTONS USING A HIGH FREQUENCY TRANSITION FOR A CYCLOTRON. J. Thirion, R. Beaurtey, and A. Papineau (Centre d'Etudes Nucléaires, Saclay, France). Helv. Phys. Acta, Suppl. 6, 108-21(1961). (In French)

A method is described for producing polarized protons, consisting of the following steps: production of a jet of atomic H; elimination of the two hyperfine states with $M_J = -\frac{1}{2}$ by means of a sextupole Stern-Gerlach type magnet; and the transition of one of the remaining two hyperfine states into the other by means of an adiabatic $0 \rightarrow 0$ transition induced in a r-f cavity. The application of this method to the production of polarized deuteron beams is discussed. (T.F.H.)

4771 EXPERIMENTS ON DYNAMIC POLARIZATION OF PROTONS IN POLYETHYLENE BY THE 'SOLID EFFECT'—A PROPOSED POLARIZED PROTON TARGET. C. F. Hwang and T. M. Sanders, Jr. (Univ. of Minnesota, Minneapolis). Helv. Phys. Acta, Suppl. 6, 122-33 (1961). (In English)

Targets for scattering experiments, composed of polarized nuclei (particularly protons), are considered. Desirable proton target criteria, such as the magnitude of the polarization, the effects of the beam on the polarization, the characteristics of the matrix in which the protons are to be located, etc., are reviewed. Within the framework of these criteria, static and dynamic methods for obtaining polarized targets are evaluated. A method utilizing the "solid effect" is found to be promising. In the solid effect, a microwave magnetic field is applied to a target containing paramagnetic centers, and the nuclei are polarized through spin-flip processes. A target consisting of radiation-damaged polythene is described. (T.F.H.)

4772 ATTEMPTS TO PRODUCE H 2 S BY CHARGE EXCHANGE. I. Alexeff (Universität, Zurich). Helv. Phys. Acta, Suppl. 6, 134-5(1961). (In English)

An attempt is described to produce an ~50% polarized proton beam, by means of the proton charge exchange reaction on atomic H at 150 to 600 ev. Metastable H formed in this reaction is to be subsequently ionized. No metastable H is detected, however; this absence is explained by calculations. (T.F.H.)

4773 AN E-H GRADIENT SPECTROMETER. J. Eisinger (Bell Telephone Labs., Inc., Murray Hill, N. J.), B. Bederson, K. Rubin, and A. Salop. Helv. Phys. Acta, Suppl. 6, 136-7(1961). (In English)

An instrument is described having an electric field E, with a gradient ∇E, superimposed on a magnetic field H, with a gradient ∇H. For measuring the polarizability of most atoms, the spectrometer is operated under the conditions $\nabla E/E = \nabla H/H \approx 3$ cm^{-1}, and at intermediate H values. The instrument is designed to measure the polarizabilities of the various m_I states of the alkali metals. Modifications necessary for measurements on H are discussed. (T.F.H.)

4774 POLARIZATION OF NUCLEI BY MACROSCOPIC ROTATION. S. P. Heims (Raytheon Co., Wayland, Mass.). Helv. Phys. Acta, Suppl. 6, 138-9(1961). (In English)

A theoretical study is made of the polarization induced in nuclei in a crystal that is rotating in a fixed external magnetic field. It is suggested that the dipole-dipole interaction between nuclei may be responsible for bringing about the polarization. The relation between the rotating crystal-fixed magnetic field and fixed crystal-rotating magnetic field results is discussed. (T.F.H.)

4775 PROPOSAL FOR DETECTING THE POLARIZATION OF SLOW PROTONS. J. Heberle (Argonne National Lab., Ill.). Helv. Phys. Acta, Suppl. 6, 140-2(1961). (In English)

A method is proposed for measuring the polarization of protons having a kinetic energy of about 10 kev. The method is based on the properties of metastable hydrogen atoms. (auth)

4776 DYNAMIC POLARIZATION OF NUCLEI. M. Borghini and A. Abragam (Centre d'Etudes Nucléaires, Saclay, France). Helv. Phys. Acta, Suppl. 6, 143-5(1961). (In French)

The so-called "solid effect" is used to produce proton polarizations of ±5 and ±19% in paramagnetic-radical-containing polystyrene and $La_2Mg_3(NO_3)_{12} \cdot 24H_2O$ respectively, and F nucleus polarizations of ±6% in LiF. A constant magnetic field is applied to the sample, plus a r-f field having a frequency equal to the electron Larmor frequency ± the nuclear Larmor frequency. (T.F.H.)

4777 POLARIZATION OF PROTONS BY AN A. C. SEXTAPOLE MAGNETIC FIELD. N. W. Tanner (Clarendon Lab., Oxford) and J. J. Domingo. Helv. Phys. Acta, Suppl. 6, 146(1961). (In English)

It is suggested that nuclear polarizations >50% might be achieved for atomic H by using an a-c sextipole field of magnetic field intensity $|H| = \alpha r^2(1 - \cos\omega t)$. The equation of motion of a magnetic dipole in this field would be $m\ddot{r} = -2\mu_{eff}\alpha(1 - \cos\omega t)r$. Divergences on the order of e^4/meter are shown to be feasible with this type of field. (T.F.H.)

4778 POLARIZATION MEASUREMENTS OF D-D NEUTRONS BY A SOLENOID. C. C. Jonker (Universiteit, Amsterdam). Helv. Phys. Acta, Suppl. 6, 160-5(1961). (In English)

A method is described for determining the polarization of neutrons from the reaction $D(d,n)He^3$, at d energies up to 500 kev, by measuring the left-right asymmetry in the scattering of these neutrons from C. Two stilbene detectors are used in conjunction with the C target. Rather than rotating the detectors through 180° in order to measure the asymmetry, the neutrons are passed through a solenoid in which the current may be reversed, thus rotating the neutrons' plane of polarization either +90° or −90°. (T.F.H.)

4779 POLARIZATION IN SOME (d,n) AND (d,p) REACTIONS. PRINCIPLE OF RING POLARIMETER. H. Brinkman (Rijksuniversiteit, Groningen, Netherlands). Helv. Phys. Acta, Suppl. 6, 166-74(1961). (In English)

The polarizations of neutrons from reactions $D(d,n)He^3$ and $T(d,n)He^4$, and of the protons from reactions $Be^9(d,p)Be^{10}$ and $Li^6(d,p)Li^7$, are measured as functions of the n and p emission angles and the d energies from 0.2 to 1.8 Mev. In addition, a ring polarimeter for measuring nucleon polarizations is described. (T.F.H.)

4780 DETECTION OF DEUTERON ALIGNMENT WITH s-WAVE REACTIONS. H. B. Willard (Oak Ridge National Lab., Tenn.). Helv. Phys. Acta, Suppl. 6, 175-80(1961). (In English)

A review is made of properties possessed by oriented deuteron beams with tensor moments up to rank 2. In particular, it is pointed out that angular distributions may result from aligned deuteron beams, even though the reaction may be initiated by s-waves and/or proceed through the contribution from a single element of the reaction matrix. Specific calculations are carried out for the 107 kev resonance in the $T(d,n)He^4$ reaction, the 430 kev resonance in the $He^3(d,p)He^4$ reaction, and the 940 kev resonance in the $C^{12}(d,p)C^{13}$ reaction. Several suggestions are made for these reactions as analyzers of deuteron alignment. (auth)

4781 PRODUCTION OF POLARIZED NEUTRON BEAMS BY (p,n) REACTIONS IN VARIOUS NUCLEI. J. P. Scanlon (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Helv. Phys. Acta, Suppl. 6, 181-92(1961). (In English)

The polarization of neutrons from (p,n) reactions at 143 Mev on Al, LiD, and LiH is measured as a function of neutron energy and emission angle. U is used as a polarization analyzing target. A 55 Mev thick Al target is found to give the highest polarizations (10 to 20%) of the targets studied, in the angular range of 35 to 55°. (T.F.H.)

4782 SURVEY OF MEASUREMENTS IN STRIPPING REACTIONS. B. Hird (Univ. of Liverpool). Helv. Phys. Acta, Suppl. 6, 193-200(1961). (In English)

The polarization of protons from (d,p) reactions on C^{12}, Be^9, and other nuclei at low and medium energies (up to 12 Mev), and the polarization of deuterons from the inverse stripping reaction $C^{12}(p,d)$ at 145 Mev, is considered. The measured polarizations are compared with the predictions of the stripping theory approximations. (T.F.H.)

4783 THE POLARIZATION OF NEUTRONS FROM THE STRIPPING OF DEUTERONS ON C^{12}. A. Budzanowski, K. Grotowski, H. Niewodniczański, J. Nurzyński, and M. Slapa (Centre of Nuclear Physics, Krakow). Helv. Phys. Acta, Suppl. 6, 215-16(1961). (In English)

The neutron polarization in the reaction $C^{12}(d,n)N^{13}$ at 12.9 Mev is measured as a function of the neutron emission angle. In addition, the neutron energy spectrum is measured at a fixed angle, in order to find the relative numbers of neutrons associated with various energy levels of N^{13}. The measured data are used to induce the properties of the N^{13} energy levels studied. (T.F.H.)

4784 LEFT-RIGHT ASYMMETRIES IN THE D(d,p)T REACTION WITH POLARIZED DEUTERONS. R. Barloutaud, H. Faraggi, A. Garin, and L. Rosen (Centre d'Etudes Nucléaires, Saclay, France). Helv. Phys. Acta, Suppl. 6, 217-18(1961). (In English)

The left-right asymmetry of the protons from the reaction D(d,p)T is measured as a function of the center-of-mass emission angle of the protons. The deuterons are incident at 1.4 ± 0.3 Mev, and are almost completely vectorially polarized. The experimental results are compared with the predictions of the stripping approximation. (T.F.H.)

4785 PRODUCTION OF SPIN POLARIZED MASS-THREE BEAMS. J. E. Brolley, Jr., J. L. Gammel, and L. Rosen (Los Alamos Scientific Lab., N. Mex.). Helv. Phys. Acta, Suppl. 6, 220-3(1961). (In English)

A technique is described for producing a 7.2-Mev triton beam having 80 to 90% polarization. In order to produce this beam, a tritium target is bombarded with 16.4-Mev α particles; the tritons ejected from the target at a laboratory angle of 45° are collimated to form the desired beam. The triton polarization in the beam is measured by scattering the beam in He^4. (T.F.H.)

4786 MEASUREMENTS OF POLARIZATION IN $C^{12}(p,p)$ SCATTERING. J. E. Evans (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Helv. Phys. Acta, Suppl. 6, 239-48(1961). (In English)

The polarization of protons induced by scattering from C^{12} is measured at 3 to 7 Mev. The polarization is found to vary from −30 to −90%. (T.F.H.)

4787 POLARIZATION IN PROTON-HELIUM AND PROTON-CARBON ELASTIC SCATTERING. J. Sanada (Tokyo Univ.). Helv. Phys. Acta, Suppl. 6, 249-52(1961). (In English)

The polarization of protons scattered from He near 10 Mev is measured, and compared with polarizations calculated from phase shift analyses. The polarization of protons elastically scattered from C at 8 to 18 Mev is measured as a function of proton energy and scattering angle. The uses of these two scattering reactions as proton polarization analyzers are compared. (T.F.H.)

4788 POLARIZATION IN p-He^4 AND p-p SCATTERING AT 22 MeV. H. E. Conzett, G. Igo, and A. Nir (Univ. of California, Berkeley). Helv. Phys. Acta, Suppl. 6, 253-8(1961). (In English)

A method is described for producing a 100% (within 0.3%) polarized beam of protons at 22 Mev. A 43.1 Mev beam of α particles is incident on a H_2 target, and the protons ejected from the target at a laboratory angle of 25° has the desired energy and polarization. The scattering of these polarized protons by H and He^4 nuclei is studied. (T.F.H.)

4789 PROTON POLARIZATION MEASUREMENTS AROUND 17 MeV. K. W. Brockman, Jr. (Inst. for Nuclear Studies, Amsterdam). Helv. Phys. Acta, Suppl. 6, 259-68 (1961). (In English)

Work on proton polarization for energies around 17 Mev is reviewed. Proton-alpha polarization measurements are emphasized. (auth)

4790 POLARIZATION OF NEUTRONS SCATTERED FROM Li^6 AND Li^7. S. E. Darden, C. A. Kelsey, and T. R. Donoghue (Univ. of Notre Dame, Ind.). Helv. Phys. Acta, Suppl. 6, 269-76(1961). (In English)

Asymmetries in the scattering of neutrons from Li^6 and Li^7 are measured at neutron energies of 0.1 to 1 Mev. The incident neutrons are produced in the reaction $Li^7(p,n)$, and thus have an initial polarization of about 40%. The polarization of the scattered neutrons is discussed in terms of phase shifts. (T.F.H.)

4791 POLARIZATION RESULTING FROM ELASTIC NUCLEON SCATTERING BELOW 4 MeV. H. R. Brugger (Swiss Federal Inst. of Tech., Zurich). Helv. Phys. Acta, Suppl. 6, 277-90(1961). (In English)

Experiments are described in which an 11% polarized beam of neutrons at 3.3 Mev is elastically scattered from a deuteron target. The polarization of the outgoing neutrons and the differential cross section are found as functions of the scattering angle. In addition, the polarization of initially unpolarized 3.9-Mev protons that are elastically scattered by Al^{27}, Mg, Ti, and V is measured, and the results are compared with optical model predictions (including a spin-orbit term). (T.F.H.)

4792 ENERGY VARIATION OF NEUTRON POLARIZATION IN SCATTERING FROM ZINC, COPPER, MOLYBDENUM AND CADMIUM. D. Brown, A. T. G. Ferguson, and R. E. White (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Helv. Phys. Acta, Suppl. 6, 291-302(1961). (In English)

The polarization of 350- to 1600-kev neutrons scattered by Zn, Cu, Mo, and Cd is measured at scattering angles of 55 and 90°. The results are compared with the predictions of the optical model, taking into account spin-orbit coupling effects. (T.F.H.)

4793 APPLICATIONS OF MILLIMICROSECOND SPECTROSCOPY TO NEUTRON POLARIZATION STUDIES—METHOD AND RESULTS. L. Cranberg (Los Alamos Scientific Lab., N. Mex.). Helv. Phys. Acta, Suppl. 6, 311-24(1961). (In English)

Millimicrosecond neutron spectroscopy techniques are described, and their applications to polarization measurements are discussed. These techniques are demonstrated for the reactions Ti(n,2n), $Be^9(p,n)$, and neutron scattering by C, Fe^{56}, and Ti^{48}. Further, the polarization at various angles and neutron energies is found as a function of atomic weight. (T.F.H.)

4794 POLARISATION OF 9 MeV PROTONS ELASTICALLY SCATTERED BY C, Mg AND Al. G. W. Greenlees and A. B. Robbins (Univ. of Birmingham, Eng.). Helv. Phys. Acta, Suppl. 6, 325-31(1961). (In English)

The polarization of 9.6 Mev protons scattered by Al, C, and Mg is measured as a function of the scattering angle. The angular distributions for elastic scattering are also found. The experimental results are compared with optical model calculations. (T.F.H.)

4795 A SURVEY OF p-α ELASTIC SCATTERING AS A POLARIZATION ANALYZER. M. J. Scott (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Helv. Phys. Acta, Suppl. 6, 332-4(1961). (In English)

Several polar graphs for proton scattering by He^4 nuclei, which show the relation between the proton's energy, scattering angle, and resultant polarization, are compared. An empirically determined set of scattering phase shifts is used to find the angular dependence of the polarization at 17.5 Mev. It is found that this angular dependence is followed more closely by the Brockman polar graph than by the Gammel-Thaler polar graph. (T.F.H.)

4796 D-PHASE DEPENDENCE OF NUCLEON-HELIUM POLARIZATION. R. E. White (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Helv. Phys. Acta, Suppl. 6, 335-6(1961). (In English)

The $D_{\frac{5}{2}}$ and $D_{\frac{3}{2}}$ phase shifts in the scattering of nucleons by He are found to become appreciable above about 10 Mev. The nucleon polarization is calculated as a function of the scattering angle at 14 Mev, and the effects of discrepancies in various measured values of the D-wave phase shifts are demonstrated. (T.F.H.)

4797 OBSERVATION ON THE REACTION $Li^7(p,\alpha)He^4$ USING POLARIZED PROTONS. K. Bearpark, I. Hall, R. E. Segel, S. M. Shafroth, and N. W. Tanner (Clarendon Lab., Oxford). Helv. Phys. Acta, Suppl. 6, 337-8(1961). (In English)

The asymmetry in the α emission in the reaction $Li^7(p,\alpha)He^4$ is measured at proton energies from 0.5 to 3.5 Mev, using protons with − 25 to − 35% polarization. The results indicate that the channel spin phase γ is $\approx 200°$. (T.F.H.)

4798 THE REACTION $Li^7(p,\alpha)\alpha$ WITH POLARIZED PROTONS. C. Weddigen and H. Schopper (Universität, Mainz). Helv. Phys. Acta, Suppl. 6, 339-40(1961). (In English)

The asymmetry of the α emission in the reaction $Li^7(p,\alpha)He^4$ is studied at proton energies of 1 to 3 Mev, using protons polarized in the $C^{12}(d,p)$ reaction at a deuteron energy of 1.06 Mev. Within the statistical accuracy of the experiment, no asymmetry is found. (T.F.H.)

4799 NUCLEAR FORCES AND POLARIZATION PHENOMENA. G. Breit (Yale Univ., New Haven). Helv. Phys. Acta, Suppl. 6, 343-58(1961). (In English)

A summary is presented of experimental and theoretical determinations of the phase shifts and coupling parameters involved in nucleon-nucleon interactions, for energies of 10 to 340 Mev. Double and triple scattering results and techniques are discussed. (T.F.H.)

4800 STRIPPING THEORY IN OPERATOR FORM. J. L. Gammel (Los Alamos Scientific Lab., N. Mex.). Helv. Phys. Acta, Suppl. 6, 359-71(1961). (In English

A general form for the scattering matrix is derived, within the framework of the shell model, for stripping reactions using polarized deuterons and/or aligned nuclei. The relation of this matrix to the results of the Butler stripping theory is discussed. The special case is examined in which the spin of the target nucleus is zero. Operator techniques are derived for use in experimental work. (T.F.H.)

4801 SELECTION RULES FOR POLARIZATION IN DIRECT INTERACTIONS AND STRIPPING PROCESSES. L. J. B. Goldfarb (The University, Manchester, Eng.). Helv. Phys. Acta, Suppl. 6, 402-8(1961). (In English)

Polarization effects in direct nuclear reactions (d, t, He^3, and α stripping reactions and inelastic scattering of nucleons or heavier particles) are studied and tabulated. The distorted-wave Born approximation is used, and the effects of spin-orbit coupling are included. Tensor polarization of rank 0 to 2s (s = spin) is included. (T.F.H.)

4802 POLARIZATION CONTOURS FOR T–α AND He^3–α SCATTERING. J. L. Gammel and R. M. Thaler (Los Alamos Scientific Lab., N. Mex.). Helv. Phys. Acta, Suppl. 6, 423-4(1961). (In English)

The phase shifts for the elastic scattering of tritons and He^3 nuclei by He^4 are analyzed at bombarding particle energies of 0 to 10 Mev. From the phase shift data, a rough polar graph is constructed relating the bombarding particle energy, scattering angle, and resultant polarization. (T.F.H.)

4803 OPTICAL MODEL ANALYSIS OF PROTON-NUCLEUS ELASTIC SCATTERING DATA IN THE ENERGY RANGE 8-17 MeV. F. Bjorklund, G. Campbell, and S. Fernbach (Univ. of California, Livermore). Helv. Phys. Acta, Suppl. 6, 432-3(1961). (In English)

A nuclear model consisting of the Coulomb potential of a uniform spherical charge distribution, plus an optical nuclear potential, is used to analyze proton-nucleus elastic scattering at 8 to 17 Mev. The model fits the data for medium and heavy nuclei better than for light nuclei. (T.F.H.)

4804 STUDIES OF β^+ AND Tb^{152} CONVERSION ELECTRON SPECTRA. K. Ya. Gromov, B. S. Dzhelepov, Zh. T. Zhelev, and A. V. Kudryavtseva (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1084-7(Sept. 1961). (In Russian)

A triple focusing β spectrometer was used in studies of β^+ and conversion electron spectra. The terbium fraction was separated from a tantalum target irradiated for 2 hours with 660-Mev protons. The conversion electron spectra of the separated Tb^{152} were studied at 530 to 1550 kev. The data show 12 conversion lines. The decay scheme for Tb^{152} is developed. (R.V.J.)

4805 INTERNAL CONVERSION COEFFICIENTS OF NUCLEAR TRANSITIONS IN Yb^{171}. N. M. Anton'eva and B. S. Dzhelepov (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1088-91(Sept. 1961). (In Russian)

The internal conversion coefficients for some Yb^{171} transitions were measured by the photoconversion method. Two nuclear transitions, 668.2 and 740.9 kev, were determined. The conversion electron and photoelectron spectra are plotted. The ratio $K_{668.2}/K_{740.9} = 0.29 \pm 0.01$; the γ relative intensities = 0.26 ± 0.03. In a previously suggested Lu^{171} decay scheme, the transition 668.2 kev is placed between $^7/_2^-$ and $^9/_2^+$ and the 740.9 kev transition is found between $^7/_2^-$ and $^7/_2^+$ and $^9/_2^-$ and $^7/_2^-$. The obtained results are in good agreement for the 668.2 kev transition and for the $^7/_2^- - ^7/_2^+$ of 740.9 kev. (R.V.J.)

4806 CONVERSION ELECTRONS OF Tm^{165}. Meng-hua Kang, K. Ya. Gromov, B. S. Dzhelepov, V. Zvol'ska, and I. Zvol'skii. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1092-5(Sept. 1961). (In Russian)

The conversion electron spectrum was studied with a double-focusing β spectrometer by proton resonance at electron energies >55 kev and by magnetic probe saturation at electron energies <55 kev. The specimen was chromotographically separated from a rare earth mixture formed in a tantalum target by 660-Mev proton bombardment. The results of an investigation of Er^{165} transition energies and K-conversion intensities, tabulated with an accuracy of 0.1%, are correlated in an attempt to find new energy levels in Tm^{165}. The previously found energy levels at 590.0, 665.3, and 807.4 kev were confirmed. Levels at 507.6, 699.6, 921.1, 980.1, 1381.8, and 1429.5 kev are postulated on the basis of energy balance. (R.V.J.)

4807 CONVERSION ELECTRONS OF ERBIUM FRACTION. A. A. Abdurazakov, K. Ya. Gromov, B. S. Dzhelepov, and V. A. Khalkin (Middle-Azia Polytechnic Inst., SSSR and Joint Inst for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1096-1100(Sept. 1961). (In Russian)

Conversion electron spectra of Er isotopes produced by tantalum bombardment with 660-Mev protons were studied with a β spectrograph with a constant magnetic field in order to identify the transition energies. The lines found were assigned to the A = 161 and 158 chains. Transition energies in $Er^{160} \rightarrow Ho^{160} \rightarrow Dy^{160}$ and conversion electron spectra of $Er^{161} \rightarrow Ho^{161} \rightarrow Dy^{161}$ and $Er^{159} \rightarrow Ho^{159} \rightarrow Dy^{159}$ are tabulated. A decay scheme and analysis are given for $Er^{159} \rightarrow Ho^{159} \rightarrow Dy^{159}$, and a list of 22 unidentified lines is included. (R.V.J.)

4808 THE DECAY SCHEME OF Eu^{147}. I. Vizi, K. Gromov, B. Dzhelepov, Zh. Zhelev, and Yu. Yazvitskii (Joint Inst. for Nuclear Research, Dubna, USSR and Khlopin Radium Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1101-4(Sept. 1961). (In Russian)

A triple-focusing β spectrometer and a γ-γ coincidence scheme were used in an investigation of Eu^{147} conversion spectra and decay. Two sets of measurements between 750 to 1100 kev were made within a 48-day interval. Conversion electrons of 800, 900, 957, and 1082 kev were found. The data confirm the 900 kev transition excited in Eu^{147} decay. The γ-γ coincidences indicate transitions of 76.5 to 121, 121 to 676, 198 to 603, 121 to 780, 198 to 700, 121 to 957, and 198 to 880 kev. The obtained results confirm the existence of 198, 800, and 1080 kev. The presence of 198 to 700 and 121 to 780 kev transitions and direct transition at 900 kev permit the introduction of the 900-kev level in the Sm^{147} scheme. Positron emission was not observed in Eu^{147} decay. The upper limit of the positron spectrum intensity is found to be $(16 \pm 5)\%$ of the intensity of the 121 kev K-conversion line. (R.V.J.)

4809 CONVERSION ELECTRON SPECTRA OF NEUTRONO-DIFFICIENT Er AND Ho ISOTOPES. K. Ya. Gromov and I. S. Dneprovskii (Joint Inst. for Nuclear Research, Dubna, USSR and Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1105-14(Sept. 1961). (In Russian)

Conversion electron spectra of neutron-difficient Er isotopes were measured with a double-focusing $\pi\sqrt{2}$ β spectrometer with a half-width conversion line of 0.2 to 0.3%. Results were obtained on $Er^{161} \rightarrow Ho^{161}$ and $Er^{159} \rightarrow Ho^{159} \rightarrow Dy^{159}$ decay. Several lines with diminishing intensity at a half life of nearly one hour were found. The decay schemes are plotted and analyzed. (R.V.J.)

4810 EMISSION FROM Mn^{56}. S. S. Vasil'ev, Seng-ch'ang No, and L. Ya Shavtvalov (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1115-16(Sept. 1961). (In Russian)

Partial β spectra with corresponding γ quanta were

separated and measured in order to determine the Mn^{56} decay scheme. The β spectra, analyzed by Fermi graph, indicate three partial spectra with boundary energies of 2830 ± 40, 1030, and 750 kev with relative intensities of 60, 28, and 12% respectively. The γ spectrum, measured with a luminescence γ spectrometer, indicates 845, 1810, and 2100 kev peaks and weak γ transitions at 2530 and 2660 kev. The boundary energy of 780 ± 60 kev on the β spectrum, correlated with the 2.10 Mev γ quanta, is in good agreement with a single β spectrum, and the obtained decay scheme confirms the accepted scheme. (R.V.J.)

4811 PROPERTIES OF Li^5 AND Be^8 LOWER STATES APPEARING IN LIGHT NUCLEUS DECAY REACTIONS. S. S. Vasil'ev, V. V. Komarov, and A. M. Popova (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1117-20 (Sept. 1961). (In Russian)

The interaction of reaction products was evaluated for integral energy distribution of particles produced in compound nucleus direct decay. The energy distribution of protons produced by C^{12} decay into three α particles at primary proton energies from 15 to 30 Mev was determined. The total proton energy distributions are plotted. It is shown that the maximum distributions at 2 to 3, 2.5 to 3.5, and 3 to 4 Mev at primary proton energies of 15 to 20, 21 to 23, and 24 to 29 Mev respectively results from the final state interaction of two α particles at the ground and 2.9 Mev-levels of Be^8 and from α-p interaction at the ground level of Li^5. The maximum distributions at 1 to 2 and 0.5 to 1.5 Mev for primary protons at 21 to 23 and 26 to 27 Mev respectively results from resonance interaction between two α particles at the Be^8 11.8 Mev level and α-p interaction at the ground level of Li^5. (R.V.J.)

4812 REMARKS ON EXCITED ENERGY STATES OF ODD–ODD Ho^{166} AND Cs^{134} NUCLEI. L. F. Kalinkin, A. S. Melioranskii, and I. V. Estulin (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1124-6 (Sept. 1961). (In Russian)

The lower energy levels and γ transitions of $Dy^{166} \rightarrow Ho^{166}$ and $Ho^{165}(n,\gamma)Ho^{166}$ are analyzed. The single-particle characteristics of odd protons (Ω_p) and neutrons (Ω_n) in relation to the theory of strongly deformed nuclei were varified for excited levels of Ho^{166} on the basis of Dy^{166} decay data. The lower levels and γ transitions of Cs^{134} from the initial state appearing during thermal neutron capture are plotted. The observed processes in $Cs^{133}(n,\gamma)Cs^{134}$ are interpreted as nuclear multiplet structure. (R.V.J.)

4813 ENERGY LEVELS OF Cu^{64} EXCITED BY $Ni^{60}(p,n\gamma)Cu^{64}$ REACTION. A. K. Val'ter, I. I. Zalyubovskii, A. P. Klyucharev, and V. A. Lutsik (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1127-30 (Sept. 1961). (In Russian)

The lower energy levels of Cu^{64} and their decay were studied using the Ni^{64} (p,nγ) reaction. The threshold of the reaction calculated from the nuclear mass balance is 2450 ± 6 kev (Q = −2412 kev), while the experimentally measured threshold is 2.50 Mev (Q = −2.46 Mev). The reaction was studied with a scintillation γ spectrometer and a 60-channel analyzer. The 1-μ-thick target, bombarded by 2.3 to 3.0 Mev protons, consisted of 9.7% Ni^{58}, 6.1% Ni^{60}, 0.4% Ni^{61}, 4.0% Ni^{62}, and 79.8% Ni^{64}. The γ spectrum produced by 3.0 Mev proton bombardment (120, 162, 205, 279, 349, and 367 kev), the γ excitation functions (162, 279, and 349 kev), the total γ excitation function with E_γ = 600 kev, and the Cu^{64} energy levels are plotted and analyzed. It is shown that the observed 120-kev γ line below the (p,nγ) reaction threshold is not related to any reactions on Ni^{64}. (R.V.J.)

4814 MEASUREMENTS OF γ RAYS FROM $Si^{30}(p,\gamma)P^{31}$ REACTION. P. M. Tutakin. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1131-4 (Sept. 1961). (In Russian)

The polarization of γ rays from $Si^{30}(p,\gamma)P^{31}$ was measured. The transition of resonance levels to the P^{31} ground level was studied for the previously observed 773, 955, and 1000-kev resonances with $\frac{3}{2} \rightarrow \frac{1}{2}$ transitions. Transition to the 1.26-Mev level ($\frac{5}{2} \rightarrow \frac{3}{2}$) was studied for the 1393-kev resonance. (R.V.J.)

4815 ENERGY LEVELS OF Ne^{22} EXCITED BY REACTION $F^{19}(\alpha,p)Ne^{22}$. A. M. Romanov, E. V. Myakinin, and M. P. Konstantinova (Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1135-7 (Sept. 1961). (In Russian)

$F^{19}(\alpha,p)Ne^{22}$ reactions at α-particle energies of 10.3, 13.6, and 14.7 Mev were investigated in order to determine the Ne^{22} energy levels, especially excitation at E > 3.3 Mev. (R.V.J.)

4816 SPINS AND PARITIES OF Cd^{112}, Sn^{118}, AND Sn^{120}. O. F. Nemets and V. V. Tokarevskii (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1138-40 (Sept. 1961). (In Russian)

Angular distributions in stripping reactions on Cd^{111}, Sn^{117}, and Sn^{119} were studied at deuteron energies of 13.6 Mev, and spins and parities of Cd^{112}, Sn^{118}, and Sn^{120} were measured in order to verify the data of G. R. Satchler (Ann. Phys. 3, 275, 1958). (R.V.J.)

4817 EXCITED STATES OF Li^7 AT 9 Mev. V. G. Shevchenko and B. A. Yur'ev (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1146-8 (Sept. 1961). (In Russian)

Energy levels and excited states of $Li^7(\gamma,t)He^4$ at a Bremsstrahlung maximum of 9.5 Mev were studied using a betatron as the γ quantum source. Nine hundred and ninety-eight triton tracks were recorded with 100-μ-thick emulsion plates distributed at 30, 60, 90, 120, and 135° angles in relation to the γ beam. The angular distributions of phototritons are plotted. Quantum characteristic $\frac{5}{2}^-$ corresponds to 5.3 Mev, $\frac{5}{2}^+$ to 6.6 Mev, and $\frac{3}{2}^-$ or $\frac{5}{2}^-$ to 8.3 Mev, in good agreement with published data. (R.V.J.)

4818 ON COLLECTIVE EXCITATION EFFECTS OF THE SUPERFLUID PHASE IN ATOMIC NUCLEI ON NUCLEAR MOMENTS OF INERTIA. B. B. Dotsenko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1149-51 (Sept. 1961). (In Russian)

Collective excitations in n- and p-subsystems are quantitatively evaluated in quasi-classical approximation according to the D. Inglis scheme (Phys. Rev, 103: 1786 (1956)). It is assumed that nucleons occupy positions with pulses $P = p + M[r\vec{\Omega}]$ in a system rotating with the angular velocity Ω. The studies show that in superfluid phases proton systems remain incompressible while neutron subsystems, due to the changes in their superfluid phase structure, become partially compressed by weak perturbation (within the limits corresponding to transitions from superfluidity to normal and back). The disintegration of the neutron subsystem, according to experimental observations, results from the fact that the neutron density near the nuclear surface drops slower than the proton density. Hence, roughly speaking, the nucleus appears to be enveloped by a flocculent, loose neutron layer with a changing particle density. (R.V.J.)

4819 PAIR CORRELATIONS AND SINGLE NUCLEON LEVEL WIDTHS IN NUCLEI. V. B. Belyaev and B. N. Zakhar'ev (Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1152-5 (Sept. 1961). (In Russian)

Corrections are given to formulas for β^2 level widths derived on the basis of shell models of independent particles appearing in calculations of residual (with self-consistent field subtracted) nucleon interactions. (R.V.J.)

4820 PROBABILITIES OF E 2 AND E 1 TRANSITIONS FROM EXCITED STATES OF Tb^{159}, Ho^{165}, AND Tm^{169} NUCLEI. V. I. Popov (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1156-60 (Sept. 1961). (In Russian)

Studies are made of data on transitions in Tb^{159}, Ho^{165}, and Tm^{169} excited by γ oscillations at 560, 515, and 565 kev respectively. Transitions to the ground state and to certain intermediate states and the multiplicities and probabilities of these transitions are analyzed. Transition multiplicities and spins and parities of initial and final states are tabulated. (R.V.J.)

4821 ON THE FEASIBILITY OF DETERMINING REDUCED WIDTH USING POLARIZATION IN DIRECT NUCLEAR REACTIONS. G. L. Vysotskii (Khar'kov State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1161-2 (Sept. 1961). (In Russian)

An attempt is made to determine reduced width in stripping reactions by complex polarization instead of model approximations. It is shown that in the case of polarization phenomena, which neglect spin-orbital interactions of proton and deuteron waves with nuclei, determination of reduced width can be achieved by measuring proton polarization and p-γ correlation. The recently published data of E. Baumgartner et al. (Phys. Rev. Lett. 5, 154, 1960) on polarized deuteron sources confirm the validity of the method. (R.V.J.)

4822 ROTATIONAL STATES OF NON-SPHERICAL EVEN-EVEN NUCLEI. V. I. Belyak and D. A. Zaikin (Lebedev Inst. of Physics, Moscow). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1163-8 (Sept. 1961). (In Russian)

Rotational interactions with γ vibrational states of even-even nuclei are studied without preliminary postulation of the conservation of nuclear projection moments on the symmetry axis. The probabilities of electromagnetic transitions between rotational bands are calculated by means of derived wave functions. The results are correlated with published data, and the relation between the obtained results and the theory of non-axial nuclei is analyzed. (R.V.J.)

4823 COLLECTIVE EXCITATIONS OF NON-SPHERICAL NUCLEI. Yu. T. Grin and D. F. Zaretskii. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1169-75 (Sept. 1961). (In Russian)

The theory of $\beta-\gamma$ vibration levels is generalized for the case of non-spherical nuclei. An equation is derived for collective excitation frequencies, and the $\beta-\gamma$ excitation ratio is found in quasi-classical approximation. Previously studied β and γ vibrations for heavy nuclei (Th, U, and Pu) indicate that the β-vibration energy is smaller than the γ by a factor of ~(0.1 to 0.3) Mev. The present calculations are in agreement with these data. The theory also shows that β- and γ-excitation energies can be considerably smaller than 2Δ. The microscopic interpretation of β and γ levels proved effective, while the hydrodynamic model and the independent particle model do not explain either the absolute or relative distribution of the levels. However, comparisons of the theory with experiments using rare earths were deterred by the absence of systematical data on level positions corresponding to β excitations. (R.V.J.)

4824 DECAY SCHEME OF Eu^{145}. Yu. A. Aleksandrov and M. K. Nikitin (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1176-7 (Sept. 1961). (In Russian)

Gamma transitions and $\gamma-\gamma$ coincidences in the decay of an europium fraction, chromotographically separated from a tantalum target bombarded by 660-Mev protons, were studied with a scintillation coincidence spectrometer. The emission of Eu^{147}, Eu^{148}, and Eu^{149} was separated from the short-life Eu^{145} and Eu^{146}. A detailed investigation of Eu^{145} γ spectra at energies up to 3 Mev indicated γ transitions that are obviously between Sm^{145} levels. Transitions with energies of 530, 655, 765, 895, 1660, 1870, 2000, 2200, and 2420 kev and relative intensities of 7.3 ± 2.7, 27 ± 7, 10 ± 3, 100, 15.6 ± 0.8, 1.5, 8 ± 1, 1, and 1 respectively were determined. The $\gamma-\gamma$ coincidences indicate cascade transitions: 895−665−530−110, 895−765, 530−765, 530−520, 2000(KX), and 1660(KX) kev. Coincidences of 1660−110, 2000−110, and 2000−895 kev were not observed. The decay scheme of Eu^{145} developed on the basis of the data is included. (R.V.J.)

4825 QUADRUPOLE MOMENTS AND ISOTOPIC SHIFTS OF BARIUM ISOTOPES. N. I. Kaliteevskii, E. E. Fradkin, and M. P. Chaika (Leningrad State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1178-9 (Sept. 1961). (In Russian)

Optical spectroscopy was used in determining the nuclear quadrupole moments and nuclear shifts of levels in highly-enriched (80 to 90%) barium isotopes. The disturbance of the hyperfine structure interval rules for $6s6p^3P_1$ in Ba I was studied using the isotopic shift of two spectral lines of BaI, λ = 4599 Å ($6p^2\ ^1S_0 - 6\ ^3P_1$) and λ = 4573.9 Å ($6p^2\ ^3P_0 - 6\ ^3P_1$), and split upper levels. The shift of barium isotopes was studied using resonance spectral line BaI($6s^2\ ^1S_0 - 6s6p\ ^1P_1$), λ = 5535.6 Å. The results (in 10^{-3} cm^{-1}) showed for Ba^{138} = −4.7 ± 0.5, Ba^{136} = −0.5 ± 0.5, Ba^{134} = 0, Ba^{137} = 1 ± 0.7, and Ba^{135} = 2.9 ± 0.4. The constant magnitudes of the isotopic shifts (in 10^{-3} cm^{-1}) were 67 for $Ba^{136-138}$, 52 for $Ba^{135-137}$, and 44 for $Ba^{134-136}$; the order of error not exceeding 20%. (R.V.J.)

4826 NUMBER OF γ QUANTA PER DECAY IN Ce^{144} AND Eu^{155}. A. N. Silant'ev and B. S. Kuznetsov (Khlopin Radium Inst., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1186-7 (Sept. 1961). (In Russian)

The number of γ quanta per decay of Ce^{144} and Eu^{155} was measured by 4π $\beta-\gamma$ coincidence. The spectrum of Ce^{144} γ rays in equilibrium with Pr^{144} was plotted, and γ peaks of 36, 80, and 134 kev were observed. The spectrum of Pr^{144} was separated, and the number of γ quanta per Ce^{144} decay and the conversion coefficient were tabulated. The error factor was ~15%. The spectrum of Eu^{155} with γ peaks of 41, 86, and 105 kev was also plotted. γ quanta per decay for the above energies were 25, 32, and 16% respectively. (R.V.J.)

4827 STUDY OF THE PROPERTIES OF STRONGLY DEFORMED NUCLEI ON THE BASIS OF THE MODEL OF THE NUCLEUS, TAKING INTO ACCOUNT THE PAIR CORRELATIONS. V. G. Solov'ev (Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1198-1216 (Oct. 1961). (In Russian)

The previously described "superfluidity model" of the nucleus (Doklady Akad. Nauk SSSR, 133, 325 (1960)) is used as reference for studying the properties of strongly deformed nuclei. In particular, the spectra of energy

levels of even and odd systems are treated and corrections are introduced in the probability of β and γ transitions. This model is used to examine strongly deformed nuclei in the $174 \leq A \leq 188$ range. Experimental data obtained on one-particle levels of uneven nuclei, pair energies and β-decay probability were used for the calculations, the results of which indicate the validity of the theoretical approach. The β-transitions investigated included $Ta^{175} \rightarrow Hf^{175}$, $Ta^{177} \rightarrow Hf^{177}$, $Ta^{185} \rightarrow W^{185}$, $Ta^{183} \rightarrow W^{183}$, $Re^{183} \rightarrow Os^{183}$, and $Ta^{181} \rightarrow Hf^{181}$ processes among others. (TTT)

4828 THE $Yb^{166} \rightarrow Tu^{166} \rightarrow Er^{166}$ DECAY PROCESS. E. P. Grigor'ev, K. Ya. Gromov, B. S. Dzhelepov, Zh. T. Zhelev, V. Zvol'ska, and I. Zvol'skii (Leningrad State Univ. and Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1217-27(Oct. 1961). (In Russian)

The transformation modes of the $Yb^{166} \rightarrow Tu^{166} \rightarrow Er^{166}$ chain which were the subject of several previous studies, have been investigated to compare the sequence of the excited states of the even-even deformation of the Er^{166} nucleus with predictions of Bohr-Mottelson's collective theory of the nucleus. The electron conversion spectrum was studied on Yb fractions obtained by means of chromatographic separation of rare-earth element mixtures formed upon irradiating a Ta target with 660-Mev protons. It was found that the energy of the γ-transitions in the Er^{166} nucleus and the corresponding K-conversion lines agree well within the limits of experimental error with previously published data of K. Jacob et al. (Phys. Rev. 117, 1102 (1960)). In the calculation of the rotational levels of Er^{166} for the purpose of comparing them with axial and non-axial data of the nucleus, the adiabatic approximation was used. (TTT)

4829 COINCIDENCE BETWEEN CONVERSION ELECTRONS ORIGINATING IN THE $Ho^{160} \rightarrow Dy^{160}$ DECAY. B. S. Dzhelepov, I. Zvol'skii, and V. A. Sergienko (Leningrad State Univ. and Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1228-45(Oct. 1961). (In Russian)

Using Er^{160} preparations with a half-life of 29.4 hours which is transformed into Ho^{160} by the capture of atomic electrons, the conversion electron spectrum of the $Er^{160} \rightarrow Ho^{160} \rightarrow Dy^{160}$ chain was investigated. This spectrum differs from the $Ho^{160} \rightarrow Dy^{160}$ spectrum only in the presence of the conversion lines of the 60.1-kev transition. The study, carried out with scintillation counters and photomultipliers as electron detectors, confirmed in general the decay scheme of Ho^{160}, proposed by Grigor'ev et al. (Izvestia Akad. Nauk SSSR, 22, 101, (1958); 22, 821 (1958); 23 868 (1959)). It was found that potential levels are formed at the 581.4 (6^+)- and 1289 (5^+)-kev levels. The 405.7-kev transition takes place at least partially between the 1695.0 (4^+)- and 1289 (5^+)-kev levels. The tests confirmed that during the decay of Ho^{160} the following excitation levels are obtained: 966.6 (2^+); 1049.5 (3^+); 1156.4 (4^+) and 1695.0 (4^+)-kev. (TTT)

4830 COINCIDENCE OF THE CONVERSION ELECTRONS FROM THE DYSPROSIUM FRACTION. B. S. Dzhelepov, I. Zvol'skii, M. K. Nikitin, and V. A. Sergienko (Leningrad State Univ. and Joint Inst. for Nuclear Research, Dubna, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1246-55(Oct. 1961). (In Russian)

The coincidence of conversion electrons from the dysprosium fraction separated from Ta irradiated with 660-Mev protons was studied by means of a double-lens β-spectrometer. The measurements were started about 20 hours after the end of the irradiation. In the fraction studied, electrons from Dy^{157} ($T_{1/2}$ = 8 hrs), Dy^{155} ($T_{1/2}$ = 10 hrs), Dy^{153} ($T_{1/2}$ = 6.4 hrs) and from the daughters Tb^{155} ($T_{1/2}$ = 5 days) and Tb^{153} ($T_{1/2}$ = 62 hrs) were observed. The results indicate that the transitions with a $h\nu$ = 182.5, 83.01 and 60.77 kev form a ternary cascade; the 326.4-kev transition proposed for the $Dy^{157} \rightarrow Tb^{157}$ runs parallel with this cascade. There is a 326.4-kev excited state for Tb^{157}. The data obtained confirm the correctness of the decay mode of the $Dy^{157} \rightarrow Tb^{157}$ transition, first proposed by Mihelich et al. (Phys. Rev. 108, 989 (1957)). In the $Dy^{153} \rightarrow Tb^{153}$ decay a coincidence has been established between the K147.5 and K149.0 electrons and conversion electrons with energies of about 41 and 84.27 kev. (TTT)

4831 SUPPLEMENTARY DATA ON NEUTRON-DEFICIENT OSMIUM ISOTOPES. T. V. Malysheva and B. A. Khotin (Vernadskii Inst. of Geochemistry and Analytical Chemistry, [Moscow]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1256(Oct. 1961). (In Russian)

It was reported previously (V. I. Baranov et al., Izvestia Akad. Nauk SSSR 24, 1079 (1960)) that Os daughter samples separated from Ir have an activity with the short half-life of about 20 minutes; this is due to the Os^{184*} formed by the decay of the 3-hour Ir^{184}. By studying carefully the total activity of Os daughters, the exact value of this half-life was found to be 10 ± 0.5 minutes. Investigation of the spectrum of the Os daughter with a 100-channel pulse analyzer revealed the 185, 355, and 620 kev γ-lines, belonging to the Os^{190*} isomer. The intensity of these lines decreases with a 10-minute half-life; accordingly, if any other even, neutron-deficient Os isotopes exist, they must have a $T_{1/2}$ of less than 2 minutes. (TTT)

4832 STUDY OF THE CONVERSION ELECTRON SPECTRUM OF THE NEUTRON-DEFICIENT PLATINUM ISOTOPES. L. N. Kryukova, V. V. Murav'eva, L. Duda, T. V. Malysheva, and B. A. Khotin (Moscow State Univ. and Vernadskii Inst. of Geochemistry and Analytical Chemistry, [Moscow]). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1257-65(Oct. 1961). (In Russian)

The conversion electron spectrum of neutron-deficient Pt isotopes formed upon the bombardment of Au by 660-Mev protons was investigated with the help of a magnetic β-spectrometer; the decay processes of the 10-day half-life Pt^{188} were studied by using a β-spectrometer and a luminescence γ-spectrometer, employing the $\gamma\gamma$ and the $e\gamma$ coincidence method. The lines obtained may be divided in groups with half-lives of 10 to 11 days, 3 to 4 days, 10 to 15 hours and 2 to 3 hours. The half-lives of certain conversion lines in a fifth group could not be definitely established; 3 of them belong to the known 281-kev transition of Pt^{188} and to the 323.4- and 632.4-kev transitions of Ir^{188}, while 5 lines remain unidentified. Pt^{188} decays under formation of the odd-odd Ir^{188} nucleus. By estimating the multipolarity of the γ-transitions, the values of the Ir^{188} excited level spins could be determined. The 54.6-kev level is assumed to be a rotational one. The moment of inertia of the Ir^{188} nucleus was thereby calculated to be 2.5 times larger than the corresponding value of the neighboring even-even Os^{186}. (TTT)

4833 STUDY OF THE RADIOACTIVE RADIATION OF THE NEUTRON-DEFICIENT ISOTOPES OF HAFNIUM. V. Brabets, B. Kratsik, T. Kratsikova, Z. Miligi, M. Veis, A. Mashtalka, M. Vobetsky, and V. Gnatovitsz (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Prague and Czech Tech. Univ., Prague). Izvest. Akad. Nauk S.S.S.R., Ser. Fiz., 25: 1266-8(Oct. 1961). (In Russian)

A magnetic β-spectrometer and a single-crystal scintillation spectrometer connected to a 200-channel amplitude analyzer were used for studying the neutron-deficient isotopes of Hf prepared by the bombardment of Ta by 660-Mev protons on the synchrocyclotron of the Joint Institute for Nuclear Studies in Dubna. The following isotopes were identified in the Hf fraction separated from the Ta without using a carrier: Hf^{171} ($T_{1/2}$ = 16 hours); Hf^{173} ($T_{1/2}$ = 24 hours); Hf^{175} ($T_{1/2}$ = 70 days) and the daughter elements Lu^{171} ($T_{1/2}$ = 8.1 days) and Lu^{173} ($T_{1/2}$ = 1.4 years). The first two short half-life Hf isotopes were closely studied on the 30 to 350-kev spectral range, determining the relative intensity of the K conversion lines and the H/L ratio of Hf^{171}. The error in the determined values of the K98 and K124 lines may reach 50%; for the other lines the results indicate only the order of magnitude. The γ-spectra indicated transitions at 100 and 170 kev for Hf^{171} and at 130 and 310 kev for Hf^{173}; there are also indications concerning lines with energies of 210 and 250 kev. (TTT)

4834 PHOTODISINTEGRATION OF LITHIUM-7 BY BREMSSTRAHLUNG WITH A MAXIMUM ENERGY OF 9.5 Mev. V. G. Shevchenko and B. A. Yur'ev (Moscow State Univ.). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1269-74(Oct. 1961). (In Russian)

The $Li^7(\gamma,t)He^4$ reaction at a bremsstrahlung with a maximum energy of 9.5 Mev was investigated for the purpose of determining excitation levels occurring in this region, using the 35-Mev betatron as the γ source. The value of 9.5 Mev was chosen to ensure that the above reaction is the only one occurring under emission of charged particles. A metallic Li layer having a thickness of 2.4 mg/cm^{-2}, placed at an angle of 30° with respect to the direction of the beam, was used as the target. The existence of 5.3 ± 0.3 ($5/2^-$), 6.6 ± 0.2 ($5/2^+$) and 8.3 ± 0.3 ($3/2^-$) Mev was definitely established. The data obtained agree well with the findings of P. Erdös et al. (Nuovo cimento 12, N 5, 639 (1954)); the location of the negative parity levels 5.3 and 8.3 Mev agrees also with the Li^7 decay scheme calculated by V. V. Balashov (Zhurnal Eks. i Teoret. Fiz. 36, 1123 (1959) No. 4.) (TTT)

4835 THE PROBABILITY OF SINGLE-PARTICLE TRANSITIONS IN THE Yb^{173} NUCLEUS. E. E. Berlovich, M. P. Bonits, Yu. K. Gusev, and M. K. Nikitin (Ioffe Inst. of Physics and Tech., Academy of Sciences, USSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1275-9(Oct. 1961). (In Russian)

The average life of the 351- and 637-kev levels of Yb^{173}, formed by K-capture from the 480-day half-life Lu^{173} was determined by using a multichannel time analyzer. The method used is based on the recording of the coincidence of the x-radiations accompanying the K-capture and of the γ-quanta associated with the discharge of excited states. The data obtained indicate that the probability of rotational levels agrees satisfactorily with S. G. Nilsson's formula (Kgl. Danske Vidensk. Selskab. Mat.- fiz. Medd., 29, No. 16 (1955); the intensity law is violated because of the strong hindrance of the E1 transition to the ground state. The anomalous behavior cannot be explained by the collective model of the nucleus, although reference to superfluidity phenomena might help to clarify it. (TTT)

4836 GAMMA-RAYS INDUCED BY THE INELASTIC SCATTERING OF 2.95-Mev NEUTRONS BY IODINE-127, LANTHANUM-139 AND BISMUTH-209. L. Ya. Graudynya, K. A. Petrzhak, and A. V. Sorokina. Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1280-5(Oct. 1961). (In Russian)

In view of the contradictory results of the spectra of γ-rays originating from inelastic scattering of neutrons, studies were undertaken on the γ-spectrum caused by the inelastic scattering of 2.95-Mev neutrons by I^{127}, La^{139} and Bi^{209}. The neutron beam, obtained by the D(d,n)He^3 reaction with a Zr–Mo target saturated with deuterium, was calibrated with a standard Ra–Be source. A NaI(Tl) scintillation spectrometer with circular geometry, coupled with a 63-channel amplitude analyzer was used for studying the spectra. The Bi^{209} spectrum agreed with previously reported findings although the 1.29-Mev line reported by A. L. Androsenko et al. (Atomnaya Energiya 7 (3) 268 (1959)) was not observed; the peaks indicated Compton scattering. The spectrum of La^{139} the presence of 0.64-, 0.79-, 1.24-, 1.43-, 1.75- and 2.08-Mev lines was established; the 1.24-Mev line is probably due to cascade transition from the 1.43-Mev level to the ground state through the 0.163-Mev level, while the 0.79-Mev line is probably due to the scattering of neutrons by Pb. The I^{127} spectrum is quite complex: in addition to the previously reported lines, 3 γ-transition lines with energies of 0.49, 2.13 and 2.66 Mev were noted. (TTT)

4837 THE SPIN AND PARITY OF CERTAIN STATES OF THE Si^{30}, Zr^{91} AND Cd^{114} NUCLEI. N. I. Zaika and O. F. Nemets (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Izvest. Akad. Nauk. S.S.S.R., Ser. Fiz., 25: 1308-12(Oct. 1961). (In Russian)

The angular distribution of protons from the (d,p) reactions of Si^{29}, Zr^{90} and Cd^{113} nuclei was investigated, carrying out the measurements in the 13.6-Mev beam of the Institute of Physics Cyclotron. The ionization chamber used as spectrometer was provided with an absorber for slowing down the neutrons; powdered oxides of the enriched isotopes contained in thin polystyrene films were used as targets. As the Si target contained 29.3% Si^{28}, in addition to protons corresponding to the first excited state of Si^{30} from the Si^{29}(d,p)Si^{30} reaction, the protons of the Si^{29} ground state from the Si^{28}(d,p)Si^{29} reaction were also recorded, although the expected energy difference of 90 kev could not be observed. The angular distribution of protons of the first Si^{30} level was calculated from the total angular distribution of the Si^{28}(d,p)$Si^{29}_{(ground)}$ reaction. The data agree well with previous data obtained with 4.3-Mev deuterons. The angular distribution of protons from the $Zr^{90,92}$(d,p)$Zr^{91,92}$ reaction, corresponding to the ground state and the first excited level of the final nucleus was also determined. The angular moments transmitted to the nucleus by neutrons in the Cd^{113}(d,p)Cd^{114} reaction were found to be equal to 0 and 2 for the transition to the base state and the first excitation level (0.56 Mev) of Cd^{114}. In some cases the value of the radii of interaction were found to be smaller than anticipated because of Coulomb interaction. (TTT)

4838 THE ENERGY LEVELS OF U^{233}. R. G. Albridge (Univ. of California, Berkeley), J. M. Hollander, C. J. Gallagher, and J. H. Hamilton. Nuclear Phys., 27: 529-53(1961). (UCRL-9438(Rev.)) (In English)

The beta decay of Pa^{233} was studied by means of high resolution permanent-magnet electron spectrographs, an iron free double-focussing beta spectrometer, and a curved-crystal gamma ray spectrometer. Measured values of relative conversion electron and photon intensities are used to determine conversion coefficients and to assign multipolarities and multipole mixing ratios for the transitions in U^{233}. The quantum assignments of the levels in U^{233} are considered, by comparisons of observed beta and photon branching ratios to those predicted by theory. New transitions were observed and some of these are used to postulate new levels in U^{233}. (auth)

4839 THE K- AND L-AUGER SPECTRUM OF URANIUM. R. G. Albridge and J. M. Hollander (Univ. of California, Berkeley). Nuclear Phys., 27: 554-60(1961). (UCRL-9609) (In English)

Measurements were made of the K- and L-Auger electron spectrum of uranium, which results from the beta decay of Pa^{233}. These data are presented and compared with previously known information on the Auger transitions in heavy elements. Low energy lines, including Coster-Kronig transitions in the energy range 0.9 to 4 kev, were observed using a permanent-field electron spectrograph with source pre-acceleration. (auth)

4840 COLLECTIVE MOTION IN THE GIANT PHOTONUCLEAR RESONANCE. I. RESONANCE ENERGY FOR SPHERICAL NUCLEI AND SPLITTING FOR DEFORMED NUCLEI. Michel Fabre de la Ripelle (Laboratoire de Physique Nucléaire, Orsay, France). Nuclear Phys., 27: 561-80(1961). (In French)

In the framework of a quantal treatment of the collective model analogous to the Fujita model, the resonance energy of the collective motion and the splitting for deformed nuclei are obtained. It is pointed out that the resonance energy depends on the nuclear density but very weakly on the potential shape, the mainly significant parameters being the r.m.s. radius and the Fourier transforms of the n-p potentials for very small momentum transfers. For the comparison with experiment the Gammel-Thaler exchange potential with hard core is used with a Fermi distribution of the nuclear states and the nuclear density parameters of Hofstadter. (auth)

4841 DECAY CHAIN $Er^{158} \xrightarrow[\varepsilon]{2.5h} Ho^{158} \xrightarrow[E,\beta^+]{27\ min} Dy^{158}_{stab}$. N. A. Bonch-Osmolovskaya, B. S. Dzelepov, O. E. Kraft, and Young-Yu Wang (Leningrad Univ. and Joint Inst. for Nuclear Research, Dubna, USSR). Nuclear Phys., 27: 581-5(1961). (In English)

The existence of the radioactive chain $Er^{158} \xrightarrow{2.5h} Ho^{158} \xrightarrow{27\,min} Dy^{158}_{stab}$ is established. The change in intensity of 330-kev and 715-kev positons was observed. An analysis of the accumulation and disintegration curves at these positon energies and of positon spectra in Er and Ho isolated from Er warrants the conclusion that the β^+-spectrum with $E_{e.p.} = 1320$ kev belongs to the daughter Ho^{158}, while the β^+-spectrum with $E_{e.p.} = 780$ kev belongs to the decay of Er^{158} itself. (auth)

4842 GROSS STRUCTURE IN REACTIONS OF DEFORMED NUCLEI. R. A. Peck, Jr. (Brown Univ., Providence). Nuclear Phys., 27: 596-605(1961). (In English)

The Nilsson model is applied to determine the effect of nuclear deformation on gross structure in direct reaction spectra among intermediate nuclei. While the gross structure known for spherical nuclei is obscured to low resolution observations, it is replaced by an equally distinctive pattern whose major features are fixed relative to single nucleon levels in the undeformed well. Definite minima in the spectrum persist at magic number gaps even for fairly large deformations. Location of the gross structure pattern on a nuclear excitation scale is determined by deformation and nucleon population numbers, so that shifts of the structure among spectra of neighboring nuclei are definite and predictable. The angular distribution in each part of the spectrum should be dominated by a few specific l_{min} values even though the single particle l is not a quantum number and parities are mixed. The effects are illustrated numerically with respect to the (n,p) reaction on target isotopes of Rh, In and Sb. (auth)

4843 POLARISATION OF PROTONS ELASTICALLY SCATTERED BY Li^7 NEAR THE 441 kev RESONANCE. J. R. Rook (Univ. of Manchester, Eng.). Nuclear Phys., 27: 606-11(1961). (In English)

It is shown that the polarization effects in the elastic scattering of 441-kev protons by Li^7 depends on the ratio of the contributions of the two channel spins. The magnitude of this ratio is given by measurements on the $Li^7(p,\gamma)Be^8$ process but the sign is not determined. The polarization effects depend on this sign, being large if it is negative and small if it is positive. A shell model calculation indicates that a fit to the energy levels of Li^8 is obtained only if the sign is positive and, together with the value of the channel spin mixing ratio, identifies the value of the intermediate coupling parameter for Be^8 which is not well determined from the energy levels. It is concluded that the polarization effects in this process are probably less than 5%. (auth)

4844 LIFETIME AND g-FACTOR OF THE FIRST EXCITED STATE IN Fe^{56}. F. R. Metzger (Franklin Inst., Swarthmore, Penna.). Nuclear Phys., 27: 612-19(1961). (In English)

With the gamma rays from a gaseous source of Co^{56}, resonance scattering from the first excited state of Fe^{56} was observed. From a study of the self-absorption of the resonance radiation, a width $\Gamma = (6.2 \pm 1.0) \times 10^{-5}$ ev was obtained. Making use of the large magnetic field at the position of the iron nuclei, the rotation of the very anisotropic pattern was observed when the iron scatterer was placed in an external field perpendicular to the plane of scattering. The measured precession angle corresponds to a g-factor of $+0.53 \pm 0.16$. (auth)

4845 MEASUREMENTS OF E1 TRANSITION PROBABILITIES IN SEVERAL DEFORMED ODD-MASS NUCLEI AS A STUDY OF SINGLE PARTICLE MOTION. U. Hauser (California Inst. of Tech., Pasadena), K. Runge, and G. Knissel. Nuclear Phys., 27: 632-47(1961). (In English)

Lifetime measurements of nuclear states in the rare earth region were performed by delayed fast-slow coincidence experiments. Results: 321-kev $\frac{9}{2}+$ individual particle state of Hf^{177}, $t_{1/2} = (6.3 \pm 0.5) \times 10^{-10}$ sec; corresponding to three E1 transitions with hindrance factors $> 10^5$. 113-kev $\frac{9}{2}-$ rotational state of Hf^{177}, $t_{1/2} = (5.2 \pm 0.4) \times 10^{-10}$ sec. 396-kev $\frac{9}{2}-$ individual particle state of Lu^{175}, $t_{1/2} = (3.1 \pm 0.3) \times 10^{-9}$ sec; corresponding to three E1 transitions with hindrance factors of $\approx 10^6$. 113-kev $\frac{9}{2}+$ rotational state of Lu^{175}, $t_{1/2} \leqq 1.5 \times 10^{-10}$ sec. The E1 transition probabilities obtained, together with those of Lu^{177}, 147 kev (de Waard; McGowan) and Ta^{181}, 6.25 kev (Hauser) are analyzed in terms of the strong coupling model. The single particle wave function of the rotational levels of the $K = \frac{7}{2}-$ ground state band in Hf^{177} is perturbed, presumably by interaction with a $K = \frac{9}{2}-$ state. The five E1 matrix elements for the $K = \frac{9}{2}- \rightarrow K' = \frac{7}{2}+$ transitions in Lu^{175}, Lu^{177}, and Ta^{181} are equal within a factor < 3. From this, it is inferred that the considerable changes of the nuclear core features are of no significant influence on the single particle wave functions of the initial and of the final states. The transition probabilities deduced from configuration mixtures for the individual particle states in a Nilsson-potential are two orders of magnitude greater than the experimental values. Reducing the configuration mixture, as e.g. recently derived by Lemmer and Green from a non-local nucleon-nuclear interaction, will improve the agreement considerably. (auth)

4846 TWO-PROTON RADIOACTIVITY. V. I. Goldanskii (Goldansky) (Lebedev Physical Inst., Moscow). Nuclear Phys., 27: 648-64(1961). (In English)

Basic information is presented on two-proton radioac-

tivity. The 2p-radioactive nuclei and the optimum conditions of producing them in reactions with the participation of He^3 or heavy multi-charged ions are enumerated with the indication of the number of evaporated neutrons and the thresholds of these reactions. Estimates are made of the cross sections for the production of 2p-radioactive nuclei, which reach 0.1 to 1 mb. Under consideration are the energy and angular correlations of the two emitted protons depending on the nature of their interaction within the nucleus and outside it. The interpretation of the triple fission of nuclei with the emission of long-range alpha-particles is suggested by analogy with certain properties of two-proton decay. (auth)

4847 LEVEL STRUCTURE OF $A[r]^{40}$. Jacob Benveniste, Rex Booth, and Arthur C. Mitchell (Univ. of California, Livermore). Nuclear Phys., 27: 665-72(1961). (UCRL-6446) (In English)

The energy spectrum of inelastically scattered protons leading to excited levels in Ar^{40} was measured at bombarding energies of 7.32 and 9.39 Mev using the Livermore variable-energy cyclotron. The argon target was contained in a 7-cm diameter gas cell with mylar window extending uninterruptedly for about 300° except for the region within 15° of the beam line. The protons were observed in a "particle-namer" detector incorporating a gas proportional counter and p-n junction solid-state detector. Twenty-one levels were observed up to an excitation energy of 6.65 Mev. (auth)

4848 LOW LYING STATES OF Th^{229}. Torkild Andersen, K. Maack Bisgård, and P. Gregers Hansen (Univ. of Aarhus, Denmark). Nuclear Phys., 27: 673-80(1961). (In English)

The decay of 1.6×10^5-yr U^{233} was studied using a six gap beta spectrometer, a xenon-filled proportional counter, and scintillation spectrometers. Internal conversion electrons having energies below 100 kev were measured. The mixing ratios for the 42-kev and the 55-kev transitions agree with the assumed rotational character of the 42-kev and 97-kev states. Results concerning the 163-kev state indicate that this state is also a member of the ground state rotational band. (auth)

4849 THE K-CONVERSION COEFFICIENT OF THE 368 kev E2 TRANSITION IN ^{200}Hg. W. H. G. Lewin, B. Van Nooijen, and A. H. Wapstra (Laboratorium voor Technische Fysika, Delft, Holland). Nuclear Phys., 27: 681-7(1961). (In English)

The K-conversion coefficient of the 368-kev E2 transition in Hg^{200} was determined using K-conversion electron-gamma coincidence measurements. The result $\alpha_K = 0.0395 \pm 0.0008$ is in excellent agreement with the theoretical values computed by Rose and by Sliv and Band. (auth)

4850 EVAPORATION MECHANISM AND DIRECT EFFECT IN n, p REACTIONS ON MEDIUM WEIGHT NUCLEI. L. Colli (CISE, Milan and Università, Milan), I. Iori, S. Micheletti, and M. Pignanelli. Nuovo cimento (10), 21: 966-79(Sept. 16, 1961). (In English)

Energy spectra of protons emitted in (n,p) reactions with 14-Mev neutrons on 13 nuclides from P^{31} to Rh^{103} are presented. The presence of both evaporation and direct mechanisms is put in evidence. By comparing forward with backward spectra, an evaluation of direct-effect cross section is given. (auth)

4851 ON THE TRIPLE ANGULAR CORRELATION AND TIME REVERSAL INVARIANCE IN STRONG INTERACTION. V. De Sabbata (Istituto Nazionale di Fisica Nucleare, Bologna). Nuovo cimento (10), 21: 1058-65(Sept. 16, 1961). (In English)

The analysis on the angular correlation $\beta-\gamma-\gamma$ from unoriented nuclei is carried out by examining the case where the first γ is mixed. The simple correlation of the three directions leads to a test for the time reversal in the strong interaction without measuring the polarization of one of the two γ. The example of Ca^{47} is considered. (auth)

4852 ROTATIONAL BANDS IN THE 1p-SHELL. A. B. Clegg (Clarendon Lab., Oxford). Phil. Mag. (8), 6: 1207-13(Oct. 1961).

It is noted that certain states of 1p-shell nuclei are strongly excited in the inelastic scattering of medium energy protons from these nuclei while other states are weakly excited. It is suggested that these observations can be understood if these nuclei are distorted, with rotational bands. The connection with other nuclear models of the 1p-shell is discussed. (auth)

4853 EFFECT OF HYDROSTATIC COMPRESSION ON THE ENERGY OF THE 14.4-kev GAMMA RAY FROM Fe^{57} IN IRON. R. V. Pound, G. B. Benedek, and R. Drever (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 7: 405-8(Dec. 1, 1961).

The energy of the recoil-free fraction of γ rays emitted by nuclei bound in solids was found to be affected by temperature and by electronic configuration. Hydrostatic compression effects are measured at 295°K on the energy $h\nu$ of the recoil-free 14.4-kev γ rays emitted by 0.1-μ sec Fe^{57} bound in metallic iron. The energy temperature coefficient was also measured more accurately. (L.N.N.)

4854 FLUORESCENCE EXCITATION BY THE ABSORPTION OF TWO CONSECUTIVE PHOTONS. John F. Porter, Jr. (Johns Hopkins Univ., Baltimore). Phys. Rev. Letters, 7: 414-15(Dec. 1, 1961).

Fluorescence radiation from polycrystalline La : $PrCl_3$ was observed using two separate excitation sources. This fluorescence cannot be attributed to either source alone. The scheme is similar to N. Blocmbergen's proposal for a solid-state infrared quantum counter (Phys. Rev. Letters 2, 84(1959) which was subsequently elaborated upon (J. F. Porter, Jr., J. Appl. Phys. 32, 825(1961)). (L.N.N.)

4855 NEW APPROXIMATION FOR PAIRING FORCES IN NUCLEI. Richard R. Chasman (Argonne National Lab., Ill.). Phys. Rev. Letters, 7: 418-19(Dec. 1, 1961).

A simple method for solving the pairing-force problem is developed, which is as desirable as the quasi-particle approach in its first approximation and can be improved by an iteration technique to any desired accuracy. (L.N.N.)

4856 PRESISTENCE OF ISOBARIC CORRESPONDENCE BETWEEN NUCLEAR STATES IN MASS REGIONS WHERE ISOTOPIC SPIN IS NOT A GOOD QUANTUM NUMBER. A. M. Lane and J. M. Soper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Rev. Letters, 7: 420(Dec. 1, 1961).

An attempt is made to give the theoretical basis for the incorrectness of the assumption that the extent to which states of two isobaric nuclei are similar is determined by the degree of isotopic spin purity in the nuclei. It is shown that correspondence between isobaric nuclear states can persist well beyond the mass region where isotopic spin is a good quantum number. (L.N.N.)

4857 DIRECT INTERACTION WITH STRONG COUPLING IN NUCLEAR COLLISIONS. II. E2 EXCITATIONS. C. B. O. Mohr (Univ. of Melbourne). Proc. Phys. Soc. (London), 78: 641-9(Nov. 1, 1961).

The work of a previous paper on the effect of coupling between elastically and inelastically scattered waves for the case of E0 excitations of the nucleus throughout its vol-

ume was extended to E2 excitations. The inclusion of coupling causes inelastic cross sections to deviate even more from the distorted wave values for E2 excitations than for E0 excitations. The effect is greater for a volume interaction than for a surface interaction of equivalent strength. (auth)

4858 COHERENT AND INCOHERENT SCATTERING OF X-RAYS BY H_2 AND He. G. E. Kilby (The University, Sheffield, Eng.). Proc. Phys. Soc. (London), 78: 673-80 (Nov. 1, 1961).

An electron density map was used to obtain the coherent x-ray scattering from molecular hydrogen. The results given by the Coulson self-consistent field function are also presented, and it is shown that there is excellent agreement with previously determined results. In addition a more careful study of the incoherent scattering was made than was previously attempted. By considering two correlated wave functions for helium and hydrogen, previous approximations are shown to lead to somewhat high estimates of the total scattered intensity. For hydrogen, a maximum reduction of about 4% brings theoretical results to within 1% of the experimental values of Wollan. The momentum distribution and the corresponding shapes of the Compton lines were also considered for hydrogen and helium. It is suggested from the results obtained for molecular hydrogen that more accurate measurements of the Compton profile might afford a useful method of studying bonding electrons. (auth)

4859 GAMMA RADIATION FROM THE MEDIUM ENERGY PROTON BOMBARDMENT OF LITHIUM, BERYLLIUM, BORON, CARBON AND NITROGEN. A. B. Clegg, K. J. Foley, G. L. Salmon, and R. E. Segel (Clarendon Lab., Oxford). Proc. Phys. Soc. (London), 78: 681-94(Nov. 1, 1961).

Measurements are presented of the gamma radiation produced when lithium, beryllium, boron, carbon, and nitrogen are bombarded with 150 Mev protons, and the results are discussed with reference to the information they provide about the structure of the nuclei involved. The results include measurements of the residual states produced in (p, 2p) and (p, pn) reactions, which are, to a first approximation, measurements of the parentage of the ground state of the bombarded nucleus. These results are not consistent with a simple jj-coupling model of these nuclei and in one case where calculations are available, are consistent with an intermediate coupling model. It is shown that inelastic scattering cross sections are determined by the same matrix element as radiative transitions so that inelastic scattering is a powerful tool for picking out strong radiative transitions to nuclear ground states. (auth)

4860 THE IMPORTANCE OF CONSERVATION CONDITIONS IN DISTORTED WAVE CALCULATIONS. W. B. Somerville (University Coll., London). Proc. Phys. Soc. (London), 78: 695-7(Nov. 1, 1961).

Some recent results, using the distorted wave approximation for the 3s−3p transition in electron-sodium atom collisions are modified on the basis of a method which ensures that the conservation condition is satisfied. The resulting cross sections lie much closer to those obtained by experiment. (auth)

4861 FUSION CROSS-SECTION MEASUREMENTS WITH DEUTERONS OF LOW ENERGY. A. von Engel and C. C. Goodyear (Oxford Univ.). Proc. Roy. Soc. (London), A, 264: 445-57(Dec. 5, 1961).

A knowledge of the energy dependence of the cross section for collisions between two deuterons leading to a triton and a proton is of interest both to nuclear theory and to calculations of the rate of thermonuclear reactions. Reliable values were only available down to about 13 kev and contributions by slower particles in a distribution could not be assessed. This range is extended to lower energies which involves measurement of very small cross sections. The method of measuring the fusion cross sections made use of an intense ion beam and of the observation of the fast protons from the reaction normal to the beam over an angle 2π. The beam intensity was raised by avoiding an ion focusing system and using a simple extraction electrode with equal gas pressure in the ion source and gas target. Observation over a large angle was achieved by depositing a scintillation detector on a light guide which surrounded the target chamber. From calorimetric measurements of the beam current and measurements of the counting rate, relative cross sections were obtained for deuteron energies up to 15 kev where absolute cross sections are well known. In this way absolute values of the cross section were found from 15 to 4 kev, at which a value of 9×10^{-33} cm^2 was measured. Although the results are consistent with Gamow's relation, the cross section in the lower energy range is slightly larger than expected. (auth)

4862 RESONANCE CHARGE TRANSFER BETWEEN H(1s) AND H^+ CALCULATED BY MEANS OF AN APPROXIMATION BASED ON AN EXPANSION IN MOLECULAR EIGENFUNCTIONS. A. F. Ferguson (Queen's Univ., Belfast). Proc. Roy. Soc. (London), A, 264: 540-6(Dec. 5, 1961).

The cross section for the process $H^+ + H(1s) \rightarrow H(1s) + H^+$ was calculated for proton energies at 1 to 50 kev by means of the perturbed stationary-state approximation, with allowance for momentum transfer effects. Allowance for momentum transfer is found to decrease the cross section by 5% at 2 kev, by 16% at 5 kev, and 45% at 20 kev. For energies below about 20 kev, the calculations are within 5% of those of McCarroll (Proc. Roy. Soc. A, 264: 547 (1961)), who uses an approximation based on atomic eigenfunctions. The results are in satisfactory accord with the experimental data of Fite, Stebbings, Hummer & Brackmann (Phys. Rev. 119: 663(1960)) in the lower part of the energy range covered (where capture into excited states is unimportant). (auth)

4863 RESONANCE CHARGE TRANSFER BETWEEN H(1s) AND H^+ CALCULATED BY MEANS OF AN APPROXIMATION BASED ON AN EXPANSION IN ATOMIC EIGENFUNCTIONS. R. McCarroll (Queen's Univ., Belfast). Proc. Roy. Soc. (London), A, 264: 547-57(Dec. 5, 1961).

An expression for the cross section describing electron capture by protons in atomic hydrogen is derived from an expansion based on atomic wave functions. Full account is taken of momentum transfer and of the non-orthogonality of the wave functions of the initial and final states by the method due to Bates. The cross sections were computed for proton energies from 100 to 1 Mev. In the low energy limit, the results agree with the calculations of Dalgarno & Yadav (Proc. Roy. Soc. A, 66: 173(1953)) and in the high energy limit with the calculations of Brinkman & Kramers (Proc. Roy. Soc. Amst. 33: 973(1930)). (auth)

4864 MEASUREMENT OF THE NEUTRONIC FLUX OF THE REACTION $C^{12}(d,n)N^{13}$ BY MEANS OF THE ACTIVITY OF THE N^{13}. Arnold Keller (Universidad Tecnica Federico Santa Maria, Valparaiso). Scientia (Valparaiso, Chile), No. 113, 31-7(Jan.-Mar. 1961). (In Spanish)

The main problem of the measurement of the neutron flux of the reaction $C^{12}(d,n)N^{13}$ by means of the activity of the N^{13} is the possibility of an escape of nitrogen from the target. A method of measuring possible losses of N^{13} is described, and measurements with targets of TiC in an ac-

celerator of the Cockcroft-Walton type are reported. The formulas to compute the neutron flux from the observed activity of N^{13} are given. (auth)

4865 SCATTERING OF PROTONS BY THE TIN ISOTOPES. M. V. Pasichnik, B. F. Orlenko, V. S. Prokopenko, M. M. Pucherov, and V. I. Chirko (Inst. of Physics, Academy of Sciences, Kiev). Ukrain. Fiz. Zhur., 6: 425-6 (May-June 1961). (In Ukrainian)

Elastic scattering of 5 to 7 Mev protons by various isotopes is of great interest as in several instances great differences were observed in the angular distribution of elastically scattered protons by nuclei of intermediate weight, even for relatively small changes in the atomic number. In order to further clarify this question, the angular distribution of elastically scattered 6.8-Mev protons by the tin isotopes $Sn^{116,117,118,119\&124}$ was investigated. The enrichment varied from 74.8 to 96.8% for the various isotopes. A scintillation counter was used as detector. It was found that in the angular range larger than 90° the differential cross section is smaller than the Rutherford scattering. A similar angular distribution was obtained also with the natural isotopic mixture. With increasing mass number, a definite tendency toward decreasing the angle and divergence from Rutherford scattering was noted. As expected, the greatest differences in the angular distribution were noted at energies close to the level of the Coulomb barrier; proton scattering experiments with Sn isotopes are thus best carried out at energies from 10 to 11 Mev. (TTT)

4866 THE NUCLEAR POLARIZATION IN MESIC ATOMS IN SPHERICAL SYMMETRICAL MESON STATES. Walter Greiner (Universität, Freiburg i. B.). Z. Physik, 164: 374-88(1961). (In German)

The polarization of the atomic nucleus was calculated by the muon rotating around the nucleus in a mesic atom. The nucleus was described by the hydrodynamic model of Jensen and Steinwedel. The calculations were limited to spherical symmetrical meson states. The collective polarization of the nucleus calculated within the framework of the Jensen-Steinwedel model produces in Pb a displacement of the $1\,\underline{s}_{1/2}$ term of the mesic atom of approximately 1 kev; the energy term of the mesic atom may be safely neglected for the discussion. For the higher lying spherically symmetrical terms as $1\,\underline{p}_{1/2}$ and $2\,\underline{s}_{1/2}$ the effect decreases rapidly. For the single particle polarization not detected in the framework of the hydrodynamic model, a displacement of less than 100 ev is found with the help of the calculations carried out by Demeur and Joachain for the deuteron. (tr-auth)

4867 INVESTIGATION OF CONVERSION ELECTRONS IN THE MOSSBAUER EFFECT IN TUNGSTEN-182 WITH A MAGNETIC SPECTROMETER. Egbert Kankeleit (Technische Hochschule, Munich). Z. Physik, 164: 442-55 (1961). (In German)

The recoilless resonance absorption of γ quanta (Mossbauer effect) was detected in a β spectrometer by measurement of the conversion electrons occurring in the decay of the absorber nuclei. With this method the 100-kev transition in W^{182} was investigated with metallic tantalum as source and enriched tungsten metal as resonance absorber. The L conversion line of the 100-kev radiation surpasses at 22°K the background by 44%. From Doppler effect measurements the half life of the first excited state of W^{182} was determined as $T_{1/2} = 1.34 \pm 0.13 \times 10^{-9}$ sec. From the temperature dependence of the effect, the Debye temperature of tantalum was measured as 280 ± 10°K. The results show good agreement with other types of measurement, but contradictory to earlier Mossbauer transmission experiments. (tr-auth)

4868 ANISOTROPY OF U^{238} FISSION INDUCED BY 3-Mev NEUTRONS. I. A. Baranov, A. N. Protopopov, and V. P. Eismont (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1003-6(Oct. 1961). (In Russian)

A double ionization chamber with grids was used to investigate the dependence of the angular anisotropy of U^{238} fission induced by 3-Mev neutrons on the ratio of the fission fragment masses. The anisotropy was found to be constant for mass ratios at 1.25 to 1.65. It was also established that with an accuracy to within 3%, the angular distribution of light and heavy fragments is symmetrical with respect to an angle of 90°. (auth)

4869 INVESTIGATION OF HYPERNUCLEI PRODUCED BY 8.8 Bev PROTONS. V. A. Tumanyan, M. G. Sarinyan, D. A. Galstyan, A. R. Kanetsyan, M. E. Arustamova, and G. S. Sarkisyan (Inst. of Physics, Academy of Sciences, Armenian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1007-12(Oct. 1961). (In Russian)

Hypernuclei production by ~9-Bev protons on photographic emulsion nuclei is investigated. Fifty-four hypernuclear decay events were detected. The hypernuclei B^{10}_{Λ}, C^{11}_{Λ}, C^{14}_{Λ}, and C^{15}_{Λ} or N^{14}_{Λ} were observed for the first time. About 30% of the observed cases can be explained by the single-nucleon mechanism of Λ^0 hyperon interaction. Two decays with an anomalously large liberation of energy were observed. (auth)

4870 (γ, n) REACTION THRESHOLDS FOR SILICON ISOTOPES. A. K. Berzin and R. P. Meshcheryakov (Tomsk Polytechnic Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1013-14(Oct. 1961). (In Russian)

The (γ, n) reaction thresholds are determined for Si^{28}, Si^{29}, and Si^{30}. (auth)

4871 THE $Ne^{21}(n, \alpha)O^{18}$ REACTION ON SLOW NEUTRONS. A. I. Abramov and M. G. Yutkin. Zhur. Eksptl'. i Teoret. Fiz., 41: 1023-4(Oct. 1961). (In Russian)

The nuclear reaction $Ne^{21}(n, \alpha)O^{18}$ was detected in a neon-filled ionization chamber irradiated by thermal neutrons. The energy and effective cross section of the reaction were measured. (auth)

4872 INELASTIC SCATTERING OF PROTONS ON F^{19} NUCLEI. S. S. Vasilev, E. A. Romanovskii, and G. F. Timushev (Moscow State Univ.). Zhur. Eksptl'. i Teoret Fiz., 41: 1040-2(Oct. 1961). (In Russian)

Magnetic analysis of inelastically scattered protons with $E_p = 6.6$ Mev on F^{19} in which 5 levels are excited is performed. The cross sections and angular distributions are measured. Conclusions are drawn regarding the spin, parity, and nature of the levels. (auth)

4873 A METHOD FOR STUDYING ELASTIC SCATTERING AT HIGH ENERGIES. V. N. Kuzmin (Radium Inst., Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1046-7(Oct. 1961). (In Russian)

A nuclear recoil technique is described in which nuclear photographic plates are employed as the nuclear detector. As an example of application of the method scattering of 660 Mev protons on He^4 are described. Possibilities of the method are discussed. (auth)

4874 ASYMMETRY OF THE DOUBLE MOTT SCATTERING OF 45–245 kev ELECTRONS. P. E. Spivak, L. A. Mikaelyan, I. E. Kutikov, V. F. Apalin, I. I. Lukashevich, and G. V. Smirnov. Zhur. Eksptl'. i Teoret. Fiz., 41: 1064-8(Oct. 1961). (In Russian)

Asymmetry in the scattering of electrons with energies from 45 to 245 kev through angles $\theta_1 = \theta_2 = 120°$ was measured by studying double Mott scattering on gold nuclei. (auth)

4875 PHOTODEUTERONS FROM Al^{27}. E. D. Makhnovskii (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1091-3(Oct. 1961). (In Russian)

The ratio of the photodeuteron to photoproton yield was measured for Al^{27} irradiated with γ rays with $E_{\gamma\ max} = 35$ Mev. Within an energy range from 2.9 to 10 Mev the ratio was found to be 0.009 ± 0.007 (which is much smaller than the ratio for Cu at $E_{\gamma\ max} = 70$ Mev). (auth)

4876 TWO-ELECTRON CHARGE EXCHANGE OF PROTONS IN HELIUM DURING FAST COLLISIONS. V. I. Gerasimenko (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1104-6(Oct. 1961). (In Russian)

The integral cross section for capture of two electrons by protons in helium is calculated in the first Born approximation. (auth)

4877 LINEAR POLARIZATION OF γ-RAYS PRODUCED IN THE (d,pγ) STRIPPING REACTION. N. Men'hard and J. Zimani (Central Scientific-Research Inst. of Physics, Budapest). Zhur. Eksptl'. i Teoret. Fiz., 41: 1185-6(Oct. 1961). (In Russian)

Linear polarization of γ rays produced in the reaction (d,pγ) is determined by the distorted wave method. It is shown that with increase of the interaction of the proton and deuteron with the target nucleus the polarization decreases and a shift of the polarization plane occurs. (auth)

4878 CORRELATION OF MOTION OF FOUR NUCLEONS IN THE Po^{212} NUCLEUS. I. M. Band, L. A. Sliv, and Yu. I. Kharitonov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1274-84(Oct. 1961). (In Russian)

The excited state spectrum and the transitions between these states are calculated for a nucleus with two nucleon pairs in excess of the filled shells. Residual pair interaction is taken into account along with self-consistent potential. The importance of taking into account np-forces in such nuclei is demonstrated. (auth)

4879 CORRELATION BETWEEN THE MEAN NUMBER AND MEAN ENERGY OF FISSION NEUTRONS AND THE PROPERTIES OF THE FISSIONING NUCLEUS. V. P. Kovalev and V. S. Stavinskii. Zhur. Eksptl'. i Teoret. Fiz., 41: 1304-6(Oct. 1961). (In Russian)

The experimental data on the mean number $\bar{\nu}$ and mean energy $\bar{E}$ of instantaneous fission neutrons are considered. A correlation between $\bar{\nu}$ and the spontaneous fission periods of even-even isotopes is established. It is noted that $\bar{E}$ tends to split up depending on the parity of nucleons from the fissioning nucleus. An analysis reveals that the properties of the fissioning nucleus which are related to parity of the number of nucleons influences the fission process at all stages up to disintegration. (auth)

4880 ENERGIEVERLUSTE SCHNELLER LITHIUM- UND NATRIUM-IONEN BEI WECHSELWIRKUNG MIT EDELGASEN. (Energy Loss of Fast Lithium and Sodium Ions in Interactions with Rare Gases). Silvester Schweda. Thesis, Berlin, Technische Universität, 1961. 87p.

A method was developed for the measurement of discrete energy losses by electrons and positive ions. The arrangement was checked with 30-kev electrons. The error in the energy measurement amounted to a maximum of 0.05 ev. The energy distribution of the 30-kev electrons after the passage through rare gases showed, in agreement with earlier measurements by Dietrich, discrete energy losses of between 8 and 25 ev by means of excitation of energy levels of the rare gas atoms as well as by an ionization continuum. The energy distribution of Li^+ and Na^+ ions with an energy of 30 kev, after passage through rare gases, showed discrete energy losses of between 10 and 70 ev. They could be explained by excitation of the energy levels of the rare gas atoms, also in some cases the rare gas ions and the colliding alkali ions changed signs by simultaneous excitation and reionization in a second collision. The energy losses which appeared to be continuous could probably be traced to elastic multiple scattering. The reaction cross section for intensity decreases in the energy range of 5 to 30 kev was on the order of 10^{-16} cm^2. The fractional cross section for excitation and ionization showed a strong dependence on the type of collision process. For Li^+ ions it varied between 0.5×10^{-18} and 50×10^{-18} cm^2 at ion energies between 15 and 30 kev. For Na^+ ions at 30 kev the values were 10% smaller than for the Li^+ ions. (tr-auth)

4881 EL MECANISMO DE LAS EVAPORACIONES NUCLEARES PRODUCIDAS POR MESONES PI DE ALTA ENERGIA. (The Mechanism of Nuclear Evaporation Produced by High-Energy Pi Mesons). Orlando R. Bravo. Thesis, Tucuman, Argentina, Nacional Universidad, [nd]. 33p.

A systematic analysis of the kinematic characteristics of the nuclear fragments emitted in a high-energy disintegration permits the determination of the mechanism which governs the nuclear evaporation. The only detection instrument which permits the exact identification and measurement of heavy fragments is the nuclear photographic emulsion. Nuclear disintegration products were analyzed in a block of Ilford G5 emulsion 600-microns thick, exposed to a 4.15-Bev π-meson beam. Determinations were made of the spectral length and angular distribution of the particle tracks, as well as the angular distribution of the other evaporated particles. The spectral length of the particles reveals that in the evaporation of heavy nuclei (Br and Ag), only fragments of 2- to 3-micron range are emitted. The light nuclei (C, N, and O), on the other hand, contribute fragments with a 12-micron range. From the angular distribution, it was deduced that the nuclear evaporation occurs by means of a kinematic mechanism similar to the formation of a compound nucleus in nuclear reactions of low energy; the evaporation nuclei, extremely excited by the effects of the nuclear cascade, receives a transfer of impulse in the direction of the incident pion. The evaporation of the nucleus takes place in flight, altering the angular distribution of the particles and nucleons evaporated through the effects of the Lorentz transformation. Also, it was established that the fragment is a genuine recoil collimated in a direction opposite to the evaporated particles. In the case of heavy nuclei, the center-of-mass velocity of evaporating nuclei is negligible; the angular distribution does not suffer much from appreciable modifications in the transformation to the laboratory system. The slight anisotropy of the light particles evaporated from the heavy nuclei is explained considering the contribution of the remainder of the low-energy nuclear cascade. (tr-auth)

Particle Accelerators

4882 (ANL-6427) PARTICLE ACCELERATOR DIVISION SUMMARY REPORT, APRIL THROUGH SEPTEM-

BER 1960. (Argonne National Lab., Ill.). Contract W-31-109-eng-38. 54p.

Work is summarized in the areas of orbit theory, injector studies, ring magnet systems development, vacuum system development, the radio-frequency system, beam extraction, and targetry. (B.O.G.)

4883 (AWRE-NR/P-5/61) TIME DISPERSION IN DOUBLE FOCUSSING BUNCHING MAGNETS. B. E. F. Macefield (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Oct. 1961. 14p.

Explicit formulae are presented giving the path differences for a given input divergence in terms of the object and image distances of a bunching magnet. Calculation of the time dispersion for a given particle energy may then be easily made. The median and fringe plane dispersions are considered in the homegeneous field and constant gradient magnetic field instruments. (auth)

4884 (CERN-61-23) ETUDE DES OSCILLATIONS NON LINEAIRES A L'AIDE D'UN MODELE ANALOGIQUE A CAGE D ELECTRONS, APPLIQUEE AU MOUVEMENT DES PARTICULES DANS LES ACCELERATEURS. (Study of Non Linear Oscillations Using an Analog Model of Electron Orbits, Application to Motion of Particles in Accelerators). M. Barbier (European Organization for Nuclear Research, Geneva). Aug. 24, 1961. 115p.

Some studies on nonlinear effects in betatron oscillations of particles circulating in accelerators were accomplished in connection with the construction of the CERN proton synchrotron. In the course of the studies it was judged advantageous to construct model to electromechanically simulate these oscillations. A description of the construction of the device and the results obtained are given. (P.C.H.)

4885 (CTSL-30) AN ACHROMATIC INFLECTOR FOR THE CALTECH SYNCHROTRON. J. H. Mullins (California Inst., of Tech., Pasadena. Synchrotron Lab.). Aug. 7, 1961. Contract AT(11-1)-68. 51p.

An analytic investigation, using first order theory only, was made of a proposed achromatic inflector for the Caltech Synchrotron. Approximations and notation, matrix representation of single element, general theorems, design considerations, specific choice of system, derivation of the transmission matrix, example of actual design, general observations, synchrotron acceptance and emittance matching, sample transfer requirements, quadrupole lenses, and suggested and sample systems are discussed. The relevant dimensions and parameters for the complete suggested injection system are given. (M.C.G.)

4886 (DESY-A2.78) ZUR BERECHNUNG DES POLSCHUHPROFILS BEI MAGNETISCHEN QUADRUPOLLINSEN. (On the Calculation of the Poleshoe Cross Section in Magnetic Quadrupole Lens). D. Lublow (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 1, 1961. 45p.

The form of the solenoid, which produces in a magnetic lens an exact quadrupole field, was calculated. A method was given by which the poleshoe profile necessary for the production of as good a quadrupole field as possible can be calculated, when a specified coil form is determined in advance. (tr-auth)

4887 (NP-11152) THE NEW GENERATION OF MEDIUM-ENERGY CYCLOTRONS. K. R. MacKenzie (California. Univ., Los Angeles). Nov. 1961. Contract Nonr-233(44). 25p.

Techniques are reviewed whereby cyclotron beams can be produced with energies on the order of 100 Mev. These techniques include Thomas focusing, alternating gradient focusing, focusing by means of spiralled sectors, frequency modulation, etc. Methods for focusing a constant-frequency sector-focused cyclotron are discussed. These methods are found to fall into three groups: Thomas-type sectors with straight edges; flared flat spiralled sectors; and unflared wedge-shaped spiralled sectors. The geometry and construction of the UCLA 50-Mev cyclotron, which falls into the third group, is described. Methods for efficient beam extraction are discussed. (T.F.H.)

4888 (PIBMRI-931-61) DESIGN STUDY OF A LINEAR ELECTRON ACCELERATOR. David Menaker (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Aug. 18, 1961. Contract AF18(600)-1505. 49p. (AFOSR-1473)

A linear accelerator incorporating a bar loading structure and utilizing microwave feedback is described. The characteristics of the bar structure required for the design are the attenuation length and the coupling impedance. Methods for obtaining these parameters are discussed and the pertinent measurement techniques are described. The design of the feedback loop and the over-all characteristics of the accelerator with feedback are presented. Beam loading losses were introduced and the resultant output energy was calculated for different values of beam loading. These results are presented in the form of a curve which depicts the output energy as a function of accelerator length with beam loading as a parameter. The over-all system is described with particular mention of the auxiliary equipment needed for operation. (auth)

4889 (TID-13433) PROTON ACCELERATOR BUILDINGS AND SUPPORTING FACILITIES. DESIGN AND CONSTRUCTION COMPLETION REPORTS. (Gibbs and Hill, Inc., New York). Jan. 1961. For Princeton Univ., N. J. Forrestal Research Center). Contract AT(30-1)-1916. 62p. (PPAD-411-D)

Included in the reports are sections containing information on structural, architectural, mechanical, and electrical phases of design. Other sections are included on construction phases. Appendixes contain drawings, bid forms, specifications, design progress schedule, and construction photographs. (J.R.D.)

4890 (UCRL-9663) DISMANTLING ENCLOSURE FOR EXTERNAL CYCLOTRON TARGETS AT THE 60-INCH CYCLOTRON. George L. Wigle, Neil C. Spencer, and Edward S. Fleischer (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 6, 1961. Contract W-7405-Eng-48. 10p.

A shielded enclosure has been developed for dismantling bombarded 60-inch cyclotron "Microtargets." Consisting of a Berkeley box within a lead enclosure, it permits the operator to safely remove the target holder from the complete target block assembly, visually inspect the target itself, check it and the block for external alpha contamination, and remove both the target and the block assembly through a bagout sealing system. In case of contamination, the internal enclosure may be sealed off and removed as a unit, to be replaced with identical stand-by equipment. (auth)

4891 RESONATOR PARTICLE SEPARATOR. J. P. Blewett (to U. S. Atomic Energy Commission). U. S. Patent 3,016,458. Jan. 9, 1962.

A wave guide resonator structure is described for use in separating particles of equal momentum but differing in mass and having energies exceeding one billion electron

volts. The particles are those of sub-atomic size and are generally produced as a result of the bombardment of a target by a beam such as protons produced in a high-energy accelerator. In this wave guide construction, the particles undergo preferential deflection as a result of the presence of an electric field. The boundary conditions established in the resonator are such as to eliminate an interfering magnetic component, and to otherwise phase the electric field to obtain a traveling wave such as one which moves at the same speed as the unwanted particle. The latter undergoes continuous deflection over the whole length of the device and is, therefore, eliminated while the wanted particle is deflected in opposite directions over the length of the resonator and is thus able to enter an exit aperture. (AEC)

Plasma Physics and Thermonuclear Processes

Refer also to abstract 4256.

4892 (AFCRL-981) PROPAGATION CHARACTERISTICS OF A MAGNETO-IONIC DUCT. Technical (Scientific) Note No. 2. D. Formato and A. Gilardini (Selenia S. p. A., Rome). May 1, 1961. Contract AF61(052)-145. 39p.

The propagation characteristics of a uniform magneto-ionic duct of circular cross-section were determined for frequencies higher than the cyclotron frequency. The ratios (plasma wavelength)/(free space wavelength) and (power flowing in the plasma)/(power flowing outside) are evaluated and discussed as a function of the diameter/wavelength ratio and of the plasma permittivity for the propagation of circularly symmetrical modes. The Brillouin diagrams for frequencies higher and lower than the cyclotron frequency are also derived. (auth)

4893 (AFOSR-595) HEAT TRANSFER TO COLD ELECTRODES IN A FLOWING IONIZED GAS. Magnetogasdynamics Laboratory Report No. 61-2. James A. Fay and William T. Hogan (Massachusetts Inst. of Tech., Cambridge. Magnetogasdynamics Lab.). Apr. 1961. Contract AF49(638)-643. 21p. (AD-258251)

A slightly ionized gas (about two mole percent ionization) was formed in the wake of a detonation wave in a shock tube by introducing a solid potassium salt into the mixture as a source of ions. Electrodes of twenty mil diameter tungsten wire were placed with axes normal to the shock tube axis and separated by a variable distance along the tube axis (but with no wake interference). The heating of each electrode as a function of current was measured by determining the rate of change of electrical resistance of the electrode. Because of noise problems, the electrode current was switched off when the resistance measurement was to be made. For the duration of the experiment (about 100 microseconds), the electrode temperature did not rise more than a few hundred degrees centigrade, and the electrode voltage drop and current remained fairly steady. While voltage current characteristics could be measured for currents of 10 to 10^3 amp/cm^2 of electrode surface, electrode heating in excess of that due to the aerodynamic heating (about 2 Kw/cm^2) of the electrodes was only observable in the range of 10^2 to 10^3 amp/cm^2. In the latter range, the excess heating was found to be proportional to the current. The excess heating rate divided by the total current was measured to be 4.9 volts for the anode and 3.2 volts for the cathode. By deducting the "heating voltage drop" from the overall electrode voltage difference, a total gas resistance could be computed which was substantially constant over the current range of the heating experiments. By varying the spacing of the electrodes, it was found that the gas resistance could be explained by the geometry effects alone in combination with a gas conductivity of 3 mhos/cm, as measured by Basu for this mixture. For these experiments, the aerodynamic boundary layer thickness was 10^{-3} cm, and the electron mean free path and Debye distance at the electrode surface were 10^{-4} cm and 10^{-6} cm, respectively. The computed random ion current was about 10 amp/cm^2. The heating measurements gave the energy losses within the aerodynamic boundary layer, and in view of the overall resistance measurements, all other electrical losses appeared to be accounted for by conduction losses in the free stream. Since the anode heating was about equal to the tungsten work function, the total voltage drop of 8 volts probably appeared across the Debye sheath at the cathode, thereby giving a field of about 10^7 volts/cm. (auth)

4894 (D1-82-0007) PLASMA POWER ABSORPTION. James E. Drummond (Boeing Scientific Research Labs., Seattle). Jan. 1959. 27p.

An estimate is calculated of the electron density and energy obtainable by projecting an intense microwave signal into an enclosure containing a gas in a magnetic field. The state is considered in which the ion production rate equals the loss rate. The power transfer resonance at the electron cyclotron frequency is given primary attention. An integral equation is found relating the electron density, microwave propagation characteristics, and ionization source strength. A method for solving this equation to obtain the electron density is developed. (T.F.H.)

4895 (D1-82-0024) NOTES ON MAGNETOHYDRODYNAMICS. G. B. Whitham (Boeing Scientific Research Labs., Seattle). Summer 1959. 52p.

Notes are presented from a series of lectures on magnetohydrodynamics. Particular attention is given to shock and wave propagation in MHD media. (T.F.H.)

4896 (D1-82-0032) CONDITIONS FOR MAXIMUM POWER TRANSFER TO A PLASMA. R. A. Gerwin, B. G. Springer, and J. E. Drummond (Boeing Scientific Research Labs., Seattle). Dec. 1959. 35p.

It is shown that the presence of a probe can modify the steady-state conditions of a plasma so as to make possible a continual energy transfer between some perturbation field (e.g., a microwave field) and the plasma electrons. It is shown to be possible to choose an r-f modulated direct-current electron beam through the plasma, and a corresponding perturbation electric field, such that the power absorbed by the plasma is maximized. The conditions that maximize power absorption in the absence of any r-f beam are also derived. (T.F.H.)

4897 (D1-82-0077) HYDROMAGNETIC SHOCK TUBE. DESIGN AND PRELIMINARY EQUIPMENTS. J. Gauger (Boeing Scientific Research Labs., Seattle). Nov. 1960. 35p.

The design and construction of a shock tube are described, in which a plasma is created by shock heating a cold gas in a cylindrical container, the shock being driven by the discharge of an electrical storage system through a coaxial electrode assembly. The electrical energy storage system and the shock tube proper are described in detail. Experiments concerning shock velocities and attenuation, pinch effects, and shock spectra in the gas are discussed. (T.F.H.)

4898 (D1-82-0108) TRANSCONDUCTANCE PROPERTIES OF PLASMA. J. E. Drummond (Boeing Scientific Research Labs., Seattle). Apr. 1961. 14p.

A survey presented at the spring meeting of the American Physical Society, April 1961.

Some of the theoretically predicted as well as some of the experimentally observed effects arising from the transconductance properties of plasmas are summarized. Straight line motion, circular motion, circular and linear motion, linear vibration, and vibrational and linear drift are discussed. (M.C.G.)

4899 (D1-82-0111) ALFVÉN WAVES IN INHOMOGENEOUS MAGNETIC FIELDS. Ryszard Gajewski (Case Inst. of Tech., Cleveland and Boeing Scientific Research Labs., Seattle) and F. Winterberg (Case Inst. of Tech., Cleveland). May 1961. 34p.

A perfectly conducting, nonviscous fluid is assumed to be permeated by an inhomogeneous, time-independent external magnetic field. Propagation of small-amplitude hydromagnetic waves with the velocity vector satisfying $\operatorname{div} \vec{v} = 0$ is investigated in a curvilinear coordinate system in which the lines of the external magnetic field are chosen as coordinate lines. The case is considered in which the field lines have no torsion, and the external magnetic field has a certain symmetry (such that the field intensity is independent of one of the curvilinear coordinates). For this case it is shown that there always exists a rigorous solution of the linearized hydromagnetic equations that describes waves traveling along the lines of the external magnetic field, with the velocity of the fluid motion directed everywhere along the binormal to the local magnetic line of force. These waves either propagate freely or are attenuated, depending on the shape of the magnetic lines and on the wave frequency. An appropriate criterion for wave propagation is derived and illustrated on two numerical examples, a two-dimensional magnetic mirror model and a dipole field. (auth)

4900 (D1-82-0114) HYDROMAGNETIC WAVES IN CERTAIN INHOMOGENEOUS MAGNETIC FIELDS. Ryszard Gajewski (Boeing Scientific Research Labs., Seattle) and Friedwart Winterberg (Case Inst. of Tech., Cleveland). June 1961. 18p.

The propagation of hydromagnetic waves in a nonviscous, perfectly conducting, incompressible fluid is studied in a linear approximation, under the assumption of an unperturbed magnetic field $\vec{H}_0 = H_0(x)\hat{n}$ where $\hat{n}$ is a constant unit vector. It is shown that there are two possible types of waves: the generalized Alfvén waves, propagating along the lines of force with a velocity $u = H_0/(4\pi\rho)^{1/2}$ (ρ = density) and differing from ordinary Alfvén waves in that they may have a non-zero longitudinal velocity component; waves analogous to the gravity waves, which can, in general, propagate across the lines of force. In particular, it is shown that if $u^2 = \text{const.} + ax$, the latter waves travel in a direction perpendicular to $\hat{n}$ and to the x-axis with a group velocity $\frac{1}{4}\, a/\omega$ and a phase velocity $\frac{1}{2}\, a/\omega$. (auth)

4901 (D1-82-0118) TRANSVERSE DIFFUSION IN A QUASI-STATIC POSITIVE COLUMN. Roy R. Johnson and David A. Jerde (Boeing Scientific Research Labs., Seattle). Sept. 1961. 41p.

The transverse diffusion of a diverging positive column in a slowly varying magnetic field was measured experimentally, and compared with the corresponding steady-state theory. The theory was developed from the macroscopic equations for momentum and particle conservation, taking into account only charged particle-neutral atom collisions. Reasonable agreement was found between theory and experiment for discharge currents in helium of the order of 50 to 500 ma, pressures of 0.6 to 1.0 mm Hg, and peak magnetic fields of up to 15 kilogauss. Rise times of the magnetic field were between 1 and 8 kilogauss/m sec. Unstable behavior of the current was observed only after the peak magnetic field was reached, even though the peak values were greater than the critical values observed by Lehnert and Allen et al. for the onset of enhanced diffusion. The role of a helical instability as a mechanism giving rise to this enhanced diffusion was analyzed by Kadomtsev and Nedospasov in terms of a large radial $\vec{j} \times \vec{B}$ force which, in a large enough longitudinal magnetic field, reduced the normal tendency of such a mode to stabilize. It would seem therefore that in the present case the aximuthal electric field E_θ associated with $(\partial B/\partial t) > 0$ may provide sufficient inward radial drift to maintain stability even in the presence of this large $\vec{j} \times \vec{B}$ force. (auth)

4902 (D1-82-0121) EXPERIMENTAL STUDY OF THE DAMPING OF LONGITUDINAL ELECTRON OSCILLATIONS. Melvin J. Kofoid (Boeing Scientific Research Labs., Seattle). July 1961. 29p.

Presented at International Conference on Plasma Physics and Controlled Nuclear Fusion Research, Salzburg, Austria, 1961.

The damping of electron oscillation traveling waves in a collisionless gas was studied. No appreciable region with true uniformity of oscillation intensity and phase existed in the standing waves produced. Studies were made to establish the minimum wavelength in the plasma obtainable with different electron temperatures with as nearly as possible constant excitation energy input. The determination of the maximum number of half-wavelength loops of standing-wave potential which could be produced in plasma between plane parallel electrodes established the minimum wavelength. Data at different electron temperatures were obtained from experiments performed in different rare gases and mercury vapor. (M.C.G.)

4903 (D1-82-0125) BEAM POWER DEVELOPMENT IN A PLASMA. J. E. Drummond (Boeing Scientific Research Labs., Seattle). July 1961. 27p.

The form of electric field eigenfunctions which extremize the power delivered by a finite beam to the field are derived and these power modes are related to an instability generated by two finite beams interpenetrating a homogeneous warm plasma. Any electric field orthogonal to the (incomplete) set of these eigenfunctions produces zero power from the beam. The conduction kernel for a beam is derived and its hermitian part found. It turns out that the hermitian part is degenerate with respect to the position along the beam axis. This allows an immediate statement of the z dependence of its eigenfunctions. One might well expect this to turn out to be a simple wave traveling with a phase velocity equal to beam velocity. This is indeed the result that would have been obtained if an infinitely long beam had been studied. However, it is found that for a beam of finite plane of origin another wave, growing linearly with position, z, along the beam arises. For a special form of electric field dependence on position, $r_\perp$, normal to the z axis, this wave can be eliminated. The self consistent beam excitation and Landau damping are considered. It is found that the only admissible oscillations are orthogonal to analytic extensions of the power eigenfunctions. (auth)

4904 (NBS-7207) ON THE CRYOGENIC ASPECTS OF PROJECT SHERWOOD. Progress Report No. 7, July 1, 1961–September 30, 1961. (National Bureau of

Standards. Boulder Labs., Boulder, Colo.). Sept. 30, 1961. 6p.

Progress is reported on the development of magnets and magnet materials, refrigeration processes, and expander and bearing research. Superconducting magnets, aluminum magnets, low-temperature rectification, thermodynamic properties and cycles, flat plate test apparatus, and turbo expander are discussed. (M.C.G.)

4905 (TID-13434) THE USE OF ATOMIC BEAMS AS A PROBE FOR STUDYING LOW DENSITY PLASMAS. Quarterly Report for April 1, 1961 to June 30, 1961. (New York Univ., New York). Aug. 21, 1961. Contract AT(30-1)-2397. 6p.

Changes were made in the apparatus which significantly improved the velocity range which could be obtained in the alkali beam probe, and which improved the detection sensitivity for the neutral beam. An extension to the charge exchange apparatus was installed so that the fast neutral beam could be velocity analyzed. Preparations are being made for a study of the passage of a neutral beam through a fully ionized, low-density plasma. (M.C.G.)

4906 (UCRL-5827) HIGH-ENERGY MOLECULAR ION INJECTION INTO A MIRROR MACHINE. F. C. Gilbert, W. Heckrotte, R. C. Hester, J. Killeen and C. M. Van Atta (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 1960. Contract W-7405-eng-48. 26p.

A study was made of the feasibility of injection of molecular ions into a mirror machine. The device considered used an axial arc to dissociate and trap the ions. Multiple passes through the arc were obtained by injection at an angle and by precessing the molecular ions so that they missed the inflector for a limited number of traversals of the machine length. The build-up was calculated in a time-dependent fashion, and a parameter study was made with particular emphasis on the effect of the arc. The calculations indicated the general feasibility of the method. (auth)

4907 (UCRL-9777) CONTROLLED THERMONUCLEAR RESEARCH QUARTERLY REPORT, MARCH–JUNE 1961. (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 4, 1961. Contract W-7405-Eng-48. 157p.

Progress is reported on the Pyrotron (Magnetic Mirror) program, Astron program, Livermore pinch program, Berkeley plasma research, plasma physics studies, and engineering and technological developments. (B.O.G.)

4908 (USCEC-79-203) ELECTROMAGNETIC RADIATION FROM A DIPOLE IN AN ANISOTROPIC PLASMA. Hans H. Kuehl (University of Southern California, Los Angeles. Engineering Center). Sept. 1961. Contract AF49(638)-522. 118p. (AFOSR-1582)

The general solution to the problem of the radiation of an electric dipole in a magnetically-biased cold plasma is presented. Since the magnetostatic field causes the plasma to be anisotropic, the far field is in general quite complicated. It was found that several waves exist, traveling in different directions with different indices of refraction. These waves interfere to produce beats and amplitude modulation, also causing the resultant time-average energy flow to have components in other than the radial direction, a result which is contrary to the isotropic case. The propagation direction for the waves was determined with the aid of a digital computer for ω_p/ω and ω_g/ω between zero and 2.0. In spite of the complexity of the field, several features are evident. For the lossless case considered, the field is unbounded in certain directions for certain values of the plasma frequency and gyro-frequency. An equation is given for the directions of these singularities. In a lossy plasma these singularities no longer exist. However the field is still very large in these directions so that they may be useful for plasma diagnostics since a measurement of these directions can be easily converted to give the average plasma density. The time-average Poynting vector and the group velocity for an individual wave are shown to be purely radial although the resultant Poynting vector due to all the waves in the far zone generally has components in other directions. Various limiting cases are amenable to solution. The case of a high operating frequency is treated; it is shown that the radiation pattern is approximately identical to the isotropic case although a Faraday rotation of the field exists. The solution for very low operating frequencies is presented and the guiding nature of the magnetic field is placed in evidence, a result well known in the study of "whistlers." The solution for the important case of a large magnetostatic field is also presented. It was found that the time-average power flow is purely in the radial direction although there are two waves present in the far zone. The effect of losses was considered briefly for the case of a large magnetostatic field; the main effect was a reduction of the poles to form large lobes of the radiation pattern. The results for an infinite magnetostatic field are also applicable to a uniaxial crystal; the similarities are pointed out. (auth)

4909 (USCEC-83-209) TRANSPORT PROCESSES IN A PLASMA (KINETIC EQUATION FOR A PLASMA) (thesis). Toyoki Koga (University of Southern California, Los Angeles. Engineering Center). Oct. 1961. Contract AF49(638)-831. 23p. (AFOSR-1744)

The effect of Coulomb field is usually neglected in the space of radius $e^2/(3kT/2)$ surrounding a charged particle, and Fokker-Planck type equations are derived from the Liouville equation of a plasma. The effect of the inner core field, usually neglected, is shown to be present in an equation of the Fokker-Planck type as an additional term which is similar to the collision term in an equation of the Boltzmann type. It is shown that the order of this additional term may easily be larger than those of the friction and diffusion terms, the effect of the outer core field. When the effect of the outer core field is larger than that of the inner core field, the assumption of binary interaction is shown to be not feasible. The possible nonlinear and non-Markovian behavior of a particle is neglected. (auth)

4910 (SCL-T-381) INVESTIGATION ON THE EXISTENCE RANGE OF THE ELECTRODELESS RING DISCHARGE. H.-J. Strauss. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.) from Ann. Physik (7) 1: 281-95(1958). 22p.

The frequency range between 4 and 8 Mc is the interval in which the existence range of the electrodeless ring discharge was established as a function of the pressure and of the excitation frequency pertaining to the inert gases, as well as mercury, nitrogen, oxygen, and also bromine and iodine. As a function of the coil voltage, the fields which effect the ignition of the discharge and those fields which bring about the reversal into the ring discharge were determined. The apparatus used in the experiments is described. (auth)

4911 (UCRL-Trans-742) NUCLEAR FUSION. V. S. Emel'yanov. Translated by D. A. Nimidoff (Univ. of California Lawrence Radiation Lab., Berkeley) from Nauka i Zhizn, 28: No. 7, 22-6(1961). 15p.

A review is presented of progress made in the development of methods for the production of nuclear fusion. A description is given of a method of producing fusion in the use of deuterium as a plasma in a concentrated magnetic field. (B.O.G.)

4912 (UCRL-Trans-751(L)) ON THE CORRELATION ENERGY AND THE CORRELATION POTENTIAL OF AN ELECTRON GAS. P. Gombás. Translated by Stephen G. Brush (Univ. of California Lawrence Radiation Lab.) from Acta Phys. Acad. Sci. Hung., 13: 233-8(1961). 6p.

An interpolation formula valid for the entire range of densities is derived for the correlation energy of an electron gas. With this formula, the correlation interaction of the electron in the highest filled energy level with the other electrons is represented by a correlation potential. (auth)

4913 ENERGY AND PRESSURE OF A ZERO-TEMPERATURE PLASMA. E. E. Salpeter (Cornell Univ., Ithaca, N. Y.). Astrophys. J., 134: 669-82(Nov. 1961).

The equation of state is considered for matter consisting of electrons and nuclei of atomic weight A and charge Z, at zero temperature and at densities much larger than that of the solid at zero pressure. Corrections are evaluated to the energy and pressure of a degenerate Fermi gas of noninteracting electrons, due to the following effects: classical Coulomb energy of an ion lattice with uniformly distributed electrons (this is the largest correction); Thomas-Fermi deviations from uniform charge distribution of the electrons; and exchange energy and spin-spin interactions between the electrons. The corrections increase with decreasing density, and the approximations break down when the spacing between nuclei is greater than the mean radius of the free Thomas-Fermi atom, and the formulas are not applicable to the interior of planets. At very high densities, where the electrons are extremely relativistic, the correction to the pressure is a multiplying constant factor which is 0.994, 0.986, and 0.960, respectively, for Z = 2, 6, and 26. It is shown that the nuclei form a lattice rather than a gas. At very high densities, restrictions are found on possible values for A and Z due to inverse beta decays and pycnonuclear reactions. For instance, C^{12} changes to Ne^{24} at densities above 6×10^9 gm/cc. (auth)

4914 MAGNETO-IONIC THEORY FOR A FULLY IONIZED HYDROGEN PLASMA. Arne A. Wyller (Air Force Cambridge Research Labs., Bedford, Mass.). Astrophys. J., 134: 718-23(Nov. 1961).

The effects of electron-proton and electron-electron collisions on the real refractive index, n, and the absorptivity, $c\kappa/\omega$, are evaluated for electromagnetic wave propagation in a fully ionized hydrogen plasma under the influence of an external magnetic field. The Appleton-Hartree magneto-ionic formula, as generally applied to the solar ionosphere, is retrieved in a limiting case with the conventionally adopted expression for the "effective" electron-proton collision frequency. Electron-electron collisions are significant only in the realm of gyroresonance, where they diminish the absorptivity due to electron-proton encounters. (auth)

4915 A PROPOSAL TO USE MICROWAVE CAVITIES TO STUDY THE SURFACE PROPERTIES OF HIGH DENSITY PLASMAS. F. L. Curzon and Roger Howard (Univ. of British Columbia, Vancouver). Can. J. Phys., 39: 1901-10(Dec. 1961).

It is suggested that the resonant properties of a cylindrical microwave cavity containing a highly conducting axial plasma rod could be used to obtain information about the dynamic properties of such a plasma. Two applications of the method are considered: an investigation of electrically exploded wires, and a study of the dynamics of the conventional z-pinch during its initial stages. (auth)

4916 DETECTION OF STATIONARY IONIC OSCILLATIONS IN REFLEX DISCHARGES OF HOT CATHODES. Terenzio Consoli, Rene Le Gardeur, and Lucien Slama. Compt. rend., 253: 1923-5(Oct. 30, 1961). (In French)

Some ionic oscillations were detected by Langmuir probes and beams of ultra high frequency in some reflex discharges of hot cathodes. Their characteristics are described. (tr-auth)

4917 THE PHYSICAL NATURE OF THE PRODUCTION OF MOVING STRIATIONS IN A D-C DISCHARGE PLASMA. L. Pekárek and V. Krejčí (Inst. of Physics, Czechoslovak Academy of Sciences, Prague). Czechoslov. J. Phys., B 11: 729-42(1961). (In English)

The physical nature of the stratification of the d-c discharge plasma is found and interpreted. The interpretation is based on the mathematical expression of production of periodic structure in plasma after an aperiodic disturbance, derived from an extremely simplified system of equations. Three basic phenomena occurring in the plasma of each d-c discharge are included: the dependence of the rate of ionization on the electron temperature and hence on the electric field, the production of space charges due to the different rates of diffusion of the electrons and ions, the creation of additional electric fields due to the creation of space charges. The interactions give rise to a chain, expanded in time and space, which leads to the production of moving striations. In agreement with experiment, this structure is developed only on the side toward the anode from the place where the equilibrium state is disturbed. (auth)

4918 THE EMISSION SPECTRUM OF A FREE NON-RELATIVISTIC ELECTRON IN AN IONIZED GAS. Louis Galatry (C.N.R.S., Bellevue, France). J. phys. radium, 22: 481-8(Aug.-Sept. 1961). (In French)

A Fourier integral theory of the radiation by a free electron is proposed. After applications to bremsstrahlung and cyclotron radiation, cases are studied where dynamic friction effects and rotation around the lines of force of a magnetic field are not negligible. (auth)

4919 TRIPLE RESONANCE PHENOMENON IN PLASMAS. T. J. Bellanca, R. S. Elliott, and J. J. Erlinger (Univ. of California, Los Angeles). Nature, 192: 543-4 (Nov. 11, 1961).

Oscillograms are presented which show the variation of modulation current and transmitted power during one deionization and ionization processes for six different magnetic field values. The Appleton-Hartree formula for the equivalent complex dielectric constant of weakly ionized plasmas in the presence of a steady magnetic field is reproduced in graphical form. The graphs are restricted to the case that the propagation vector and E-polarization of the electromagnetic wave are both perpendicular to the direction of a uniform steady magnetic field. The influence of the triple resonance effect was investigated using an apparatus similar to one used earlier by Anderson. Results are reported and discussed. (C.H.)

4920 A NEW APPLICATION OF THE FARADAY MAGNETO-OPTICAL EFFECT FOR DIAGNOSTIC MEASUREMENTS OF TRANSIENT MAGNETIC FIELDS. R. D. Medford, W. H. W. Fletcher, J. D. Herbert, and A. L. T. Powell (Atomic Weapons Research Establishment, Foulness, Southend on Sea, Eng.). Nature, 192: 622-4(Nov. 18, 1961).

A technique for recording time variations in a longitudinal

magnetic field which makes use of the Faraday magneto-optical effect is described. The method uses simple inexpensive apparatus and is easily incorporated into experiments already using streak camera observations. An experiment is described for measuring the driving magnetic field inside a theta piece. A schematic diagram of the optical system is shown. By combining the magneto-optical technique and the methods for superimposing streak and optical interference fringe photographs on the same emulsion, it should be possible to determine geometry, space-time distribution of electron number density in a high-density plasma (about 10^{17} cm^{-3}), and line-integrated variations of magnetic field along the line of sight with one streak camera. (N.W.R.)

4921 STABILITY CRITERION FOR ARBITRARY HYDROMAGNETIC EQUILIBRIA. John M. Greene and John L. Johnson (Princeton Univ., N. J.). Phys. Rev. Letters, 7: 401-2(Dec. 1, 1961).

In a hydromagnetic fluid model, an equilibrium configuration is determined by $\vec{J} \times \vec{B} = \vec{\nabla} p$, $\vec{J} = \vec{\nabla} \times \vec{B}$, and $\vec{\nabla} \cdot \vec{B} = 0$. The general solutions of these equations for spatially-bounded systems have the properties that the lines of force lie on surfaces, called magnetic surfaces, which are topologically nested toroids. Stability criteria, tractable only in suitably chosen coordinate systems, are derived. An example given is that of a nonorthogonal system in which a magnetic surface is labeled by the volume V which it contains and a line of constant θ and ζ intersects each surface once. (L.N.N.)

4922 REFLECTION OF ELECTROMAGNETIC WAVES BY PLASMA. V. I. Kurilko and V. I. Miroshnichenko (Physico-Technical Inst., Academy of Sciences, Khar'kov). Ukrain. Fiz. Zhur., 6: 415-16(May-June 1961). (In Ukrainian)

The increase in the amplitude and the frequency of electromagnetic waves reflected by moving objects may be used to amplify these waves. Ya. B. Faĭnberg pointed out that at non-relativistic velocities this increase may be detected by changes in the phase velocity. An equation has been derived for determining the pertinent reflection coefficients for arbitrary parameters of the plasma and the dielectric under conditions of spatial dispersion. (TTT)

4923 THE EFFECT OF ELECTROSTATIC INSTABILITIES ON THE ELECTRIC CONDUCTIVITY AND THE TEMPERATURE OF PLASMA. V. D. Shapiro (Physico-Technical Inst., Academy of Sciences, [Khar'kov]). Ukrain. Fiz. Zhur., 6: 426-9(May-June 1961). (In Ukrainian)

In the case of a strong electric field, $E_0 > E_{cr}$, the slowing down of the plasma electrons by twin collisions is greatly diminished; the electron gas accelerated by the field creates a run-away electron beam. The slowing-down effect is the result of the plasma oscillations. The small oscillations caused by thermal fluctuations are amplified by the electron flux the velocity of which is higher than the thermal conductivity rate. To define the electric conductivity of the plasma in strong electric fields, kinetic equations were derived. It was shown that dissipation without collisions in the plasma excited by the electron flux leads to a rapid increase of the thermal energy of the plasma. (TTT)

4924 PHENOMENOLOGICAL CONSIDERATION ON THE PHOTON-ELECTRON INTERACTION IN A PLASMA. Heinrich Horl and Henning Mueller (Universität, Mainz). Z. Physik, 164: 359-66(1961). (In German)

The possibility of a simple physical connection between the Richardson equation for thermionic emission and the Richardson equation for photoelectric emission was studied. The proposition of such a connection is based on the following supposition: that electrons are not only elements of a (Fermi-Dirac) statistical ensemble and, as such, cause thermionic phenomena; but that they can also interact with a radiation field, thereby causing an additional emission current, according to the Richardson (photoelectric) equation. It is shown in detail that the current emitted from a metal of 2000°K is determined by the complete radiation of this metal only to a very slight degree. It is then estimated however, that within temperatures of some million degrees Kelvin the excitation of electrons caused by complete radiation will be much greater than that caused by interaction. (auth)

4925 ELECTROSTATIC INSTABILITY OF AN INTENSE ELECTRON BEAM IN A PLASMA. M. V. Nezlin. Zhur. Eksptl'. i Teoret. Fiz., 41: 1015-22(Oct. 1961). (In Russian)

It is demonstrated that the current density in quasineutral fast electron beams propagating in a plasma is restricted from above by a value, above which the beam becomes unstable with respect to formation of a virtual cathode. The mechanism of this instability is discussed. (auth)

4926 ON THE ENERGY LEVEL SHIFT IN PLASMA ATOMS. L. E. Pargamanik (Khar'kov State Univ.). Zhur. Eksptl'. i Teoret. Fiz., 41: 1112-18(Oct. 1961). (In Russian)

A theory for the level shift of single-electron atoms in an equilibrium plasma is developed. The level shift is computed in the first and second approximations with respect to the coupling constant $e^2/2aT$ (a is the Bohr radius). Debye screening is taken into account by diagram summation. At high temperatures ($T \gtrsim 10^6$ K) the shift is determined by exchange interaction between the electrons and grows as $T^{1/2}$. The problem of calculation of the level widths is discussed. (auth)

4927 QUANTUM THEORY OF THE DIELECTRIC PERMEABILITY TENSOR FOR AN ELECTRON PLASMA IN A MAGNETIC FIELD. P. S. Zyryanov and V. P. Kalashnikov (Urals Polytechnic Inst., USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1119-24(Oct. 1961). (In Russian)

A quantum theory of the complex dielectric permeability tensor of an electron plasma in a magnetic field is developed by taking into account quantization of the electron-orbital motion in a magnetic field. Transition to the classical and quasiclassical cases is investigated and the connection with some familiar results is established. The limiting quantum case is investigated. Expressions for the anti-Hermitian part of the tensor which is responsible for dissipation are derived. The dependence of the interaction screening range on the magnetic field strength is discussed. (auth)

4928 THEORY OF PLASMA DIFFUSION IN A MAGNETIC FIELD. V. L. Gurevich and Yu. A. Firsov (Inst. of Semiconductors, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1151-67(Oct. 1961). (In Russian)

The transverse diffusion coefficient for particles in a completely ionized plasma in a magnetic field is calculated by a graphical method. The Born parameter $e^2/\hbar v_T$ is assumed small. The magnetic field is considered to be strong, the electron Larmour frequency being considerably larger than the collision frequency. The role of electrons and ions in screening the electron–ion interaction, deformation of the interacting particles Debye clouds and also the inelastic nature of electron–ion scattering are taken into account. The numerical factor under the Cou-

lomb logarithm is estimated in the case when the electron Larmour radius is much greater than the Debye radius. Corrections to the diffusion coefficient due to the effect of the magnetic field on electron–ion collisions are estimated. The case when the Debye radius is smaller than the electron, but larger than the ion Larmour radius and when the magnetic field exerts a significant influence on the collision act is also considered. (auth)

4929 A MORE PRECISE DETERMINATION OF THE KINETIC COEFFICIENTS OF A PLASMA. O. V. Konstantinov and V. I. Perel (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret Fiz., 41: 1328-9(Oct. 1961). (In Russian)

Kinetic coefficients for a plasma are derived which contain exact values of the Coulomb logarithm. The case $\omega\tau \ll 1$, $e^2/\hbar v \ll 1$ is considered. (auth)

4930 RADIATION AND WAVES IN PLASMAS. Morton Mitchner, ed. Fifth Lockheed Symposium on Magnetohydrodynamics. Stanford, California, Stanford University Press, 1961. 162p. $4.50.

Seven papers are included which were presented at the Fifth Annual Magnetohydrodynamics Symposium held in Palo Alto, Calif., on Dec. 15 and 16, 1960. Attention was focused on the subjects of radiation and waves in plasma. Separate abstracts were prepared for five of the papers; the remaining two were previously abstracted in NSA. (D.L.C.)

4931 STATIC EQUILIBRIA, STABILITY, AND WAVE PROPAGATION IN SYMMETRICAL COLLISIONLESS PLASMAS. Ira B. Bernstein (Princeton Univ., N. J.). p.19-53 of "Radiation and Waves in Plasmas." Stanford, California, Stanford University Press, 1961.

A theoretical investigation is made of the stability and wave propagation in plasmas where collisions are negligible, particularly inhomogeneous hot systems. Particle motions are considered and applied to self-consistent steady states. The choice and consequences of the gage condition are discussed. Slab equilibria and nonlinear electrostatic waves are considered. The technique is applied to the cylindrical Langmuir probe. Finally, the problem of small motions about this class of static equilibria is formulated. (D.L.C.)

4932 THE ELECTRON-STREAM MODEL OF A PLASMA, AND THE PROBLEM OF ENERGY CONSERVATION IN LANDAU DAMPING. Oscar Buneman (Stanford Univ., Calif.). p.54-65 of "Radiation and Waves in Plasmas." Stanford, California, Stanford University Press, 1961.

The possibility of making an electron-stream model of plasmas is considered. Division of plasma into normal congruences or nonvortical streams is discussed. The use of a variational principle to express the dynamical properties of each stream is discussed. Conservation laws are derived and applied to Landau's plasma. Comparison of Boltzmann function and stream analysis shows that, for energy conservation, the stream method is more clumsy. (D.L.C.)

4933 MICROWAVE EMISSION FROM ULTRA-ENERGETIC PLASMAS. David B. Beard (Univ. of California, Davis). p.66-94 of "Radiation and Waves in Plasmas." Stanford, California, Stanford University Press, 1961.

A review is presented on the theory of microwave emission from energetic plasmas. Some numerical results are presented. It is concluded that, for frequencies comparable with the plasma frequency or with the first or second harmonic of the cyclotron frequency, the index of refraction for ordinary plasmas is different from unity and hence reflecting plasma surfaces are possible, but that for higher frequencies the index of refraction is unity. The energy loss from a plasma is discussed. (D.L.C.)

4934 SURVEY OF SOME COHERENT WAVE PROPAGATION PROPERTIES OF PLASMAS. J. E. Drummond (Boeing Scientific Research Labs., Seattle). p.98-118 of "Radiation and Waves in Plasmas." Stanford, California, Stanford University Press, 1961.

A survey is presented of the high-frequency properties of plasmas in cases where the inhomogeneous term is insignificant. Only the cases are considered where the only significant generalized high-frequency force is the r-f electric field and the only flux is the conduction-current density. Electron beams in plasmas and electron-cyclotron resonances are considered. Radiation coupling and the problem of maximizing power transfer are discussed. (D.L.C.)

4935 THERMAL GENERATION OF A FULLY IONIZED CESIUM PLASMA. G. S. Kino (Stanford Univ., Calif.). p.119-37 of "Radiation and Waves in Plasmas." Stanford, California, Stanford University Press, 1961.

A plasma with a high percentage of ionization can be produced by resonance ionization of cesium at a hot tungsten surface. A semi-quantitative picture of the behavior of a cesium plasma under these conditions was developed. Experiments on the amplification of an electron beam passing through a cesium plasma agree fairly well with theory. (D.L.C.)

4936 ZUR THEORIE DER PLASMEN UNTER BESONDERER BERÜCKSICHTIGUNG DER XENON-HOCHDRUCKENTLADUNGEN. (Plasma Theory with Special Reference to Xenon High-Pressure Discharges). Herbert Schirmer. Thesis, Berlin, Technische Universität, 1960. 187p.

Plasma theory and applications in xenon discharges are discussed. Topics covered include the theory of transport phenomena in a Lorentz gas, theory of transport phenomena in a plasma, the difference between electron temperature and gas temperature, the theory of plasma radiation, integration of the Elenbaas-Hellersche differential equation, calculation of the transport coefficient for xenon high pressure plasma, and wall stability of xenon high-pressure longitudinal arc discharges of lower pressure and less thermal wall charge. (M.C.G.)

4937 IMPROVEMENTS IN ELECTRIC DISCHARGE APPARATUS FOR PRODUCING HIGH LOCALIZED TEMPERATURES. (to English Electric Co. Ltd.). British Patent 884,705. Dec. 13, 1961.

An apparatus for carrying out thermonuclear reactions is designed which avoids the pinch instability problem by utilizing a periodic discharge. The periodic discharge is produced at a frequency which is a multiple of the cyclotron frequencies of the gaseous ions by a discharge cavity formed between the poles of a magnet producing the magnetic field. The cavity in turn is disposed within a discharge chamber having cavities which have a resonant frequency matched to the motion of the ions of the fusion products and which include electromagnetic couplings adapted to extract electrical energy from the ions at their cyclotron frequency. (D.L.C.)

4938 PLASMA DISCHARGE APPARATUS. (to U. S. Atomic Energy Commission). British Patent 884,719. Dec. 13, 1961.

An apparatus is designed for forming an energetic ion plasma and bringing about thermonuclear reactions. The

apparatus comprises an evacuated container with a confining magnetic field oriented along the container axis and magnetic mirror fields at both ends of the container. In operation, coaxial arc discharges are struck in the container with a potential gradient in-between, whereby trapping of the ion plasma is effected between the discharges. (D.L.C.)

4939 APPARATUS FOR HEATING A PLASMA. T. H Stix (to U. S. Atomic Energy Commission). U. S. Patent 3,015,618. Jan. 2, 1962.

The system contemplates the use of ion cyclotron motions for transferring energy to a plasma immersed in a confining magnetic field such as is found in thermonuclear reactors of the stellarator class. Oppositely directed windings are provided for producing ion-accelerating fields having a time and spatial periodicity and these have the advantage of producing ion cyclotron motions without the development of space charges which preclude the efficient energy transfer to the plasma. (AEC)

4940 PYROTRON WITH TRANSLATIONAL CLOSURE FIELDS. Edward C. Hartwig, David B. Cummings, and Richard F. Post (to U. S. Atomic Energy Commission). U. S. Patent 3,015,748. Jan. 2, 1962.

Circuit means is described for effecting inward translatory motion of the intensified terminal reflector field regions of a magnetic mirror plasma containment field with a simultaneous intensification of the over-all field configuration. The circuit includes a segmented magnetic field generating solenoid and sequentially actuated switch means to consecutively short-circuit the solenoid segments and place charged capacitor banks in shunt with the segments in an appropriate correlated sequence such that electrical energy is transferred inwardly between adjacent segments from the opposite ends of the solenoid. The resulting magnetic field is effective in both radially and axially adiabatically compressing a plasma in a reaction chamber disposed concentrically within the solenoid. In addition, one half of the circuit may be employed to unidirectionally accelerate plasma. (AEC)

4941 REACTOR. L. Spitzer, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,016,341. Jan. 9, 1962.

The system contemplates ohmically heating a gas to high temperatures such as are useful in thermonuclear reactors of the stellarator class. To this end the gas is ionized and an electric current is applied to the ionized gas ohmically to heat the gas while the ionized gas is confined to a central portion of a reaction chamber. Additionally, means are provided for pumping impurities from the gas and for further heating the gas. (AEC)

4942 CONTROLLED NUCLEAR FUSION REACTOR. James L. Tuck, M. Kruskal, S. A. Colgate, and M. N. Rosenbluth (to U. S. Atomic Energy Commission). U. S. Patent 3,016,342. Jan. 9, 1962.

A plasma generating and heating device is described which comprises a ceramic torus with exterior layers of a thick metal membrane and a metallic coil. In operation, the coil generates a B_z field prior to the formation of an enclosing plasma sheath. Diffusion of the trapped magnetic field outward through the plasma sheath causes enhanced heating, particularly after the sheath has been pinched. (D.L.C.)

Shielding

4943 (NP-11129) FEASIBILITY STUDY; EXPERIMENTAL INVESTIGATION OF NEUTRON AND GAMMA RAY ATTENUATION IN VARIOUS SOILS AND MATERIALS. Final Report. William W. Boynton (Boynton Associates, La Cañada, Calif.). Jan. 1959. Contract NBy-3160. 153p.

A study was made to determine the experimental feasibility of measuring neutron and gamma ray penetration in soils and materials. Problems discussed include the development of a test site, acquisition of specialized equipment and instrumentation, and conduction of experimentation of the attenuation of 14-Mev neutrons through various soils and materials. The feasibility study is given in terms of reviews of shielding studies, attenuation measurements, sources for neutron production, methods of approach to an experimental program, a recommended experimental program, and a cost estimate of such a program. Appendixes are included which discuss the evaluation of magnetic tape recording for multiple detectors, the determination of the total neutron flux with a tank of permanganate solution, and a proposal for developing instrumentation and techniques for measuring gamma ray and neutron attenuation in soils and materials. 162 references. (B.O.G.)

4944 (TID-14360) SHIELDING COMPUTER PROGRAMS 14-0 AND 14-1, REACTOR SHIELD ANALYSIS. J. T. Martin, J. P. Yalch, and W. E. Edwards (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). Jan. 23, 1959. Contract [AT(11-1)-171]. 188p. (XDC 59-2-16)

This program computes reactor-shield assembly weight and applies influence functions in the computation of neutron and gamma ray spectra and dose and energy absorption rates in and around complex reactor-shield assemblies. Source points are described by coordinates, r, z, and ϕ. Source densities, considered to be the same for neutrons and gamma rays, are specified by an input table and are independent of ϕ and non-separable in r and z. Trapezoidal integration is performed over cylindrical source regions whose axes are parallel to the main axis of the system. (auth)

4945 (UCRL-6526) NEUTRON SELF-SHIELDING IN ONE-DIMENSIONAL ABSORBERS (thesis). John S. Martinez (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1, 1961. Contract W-7405-eng-48. 252p.

Several separate, but related, problems associated with neutron self-shielding effects caused by single and multiple slab absorbers were studied experimentally. In each case simple analytical expressions were found which predicted results that are in agreement with the experiments. The neutron shelf-shielding (i.e., the ratio of the average flux inside the absorber to the surface flux) in the one-velocity model for a one-dimensional, nonscattering slab absorber immersed in a symmetric neutron field was studied. The neutron flux distortion (i.e., the ratio of the average flux inside the absorber to the flux at the same position in the absence of the absorber) in the one-velocity model caused by a one-dimensional, non-scattering slab absorber immersed in an infinite isotropically scattering medium which contains spatially constant isotropic sources was investigated. The disadvantage factor (i.e., the ratio of the average flux in the moderator to the average flux in the fuel) in the one-velocity model for an infinite, repeating, heterogeneous, slab lattice consisting of alternate layers of nonscattering absorbers and isotropically scattering moderator which contains spatially constant isotropic sources was determined. The flux distortion factor for finite radius indium absorbers embedded in a graphite medium in a thermal neutron flux was also studied. For each case, simple analytical expressions were found which

gave good agreement with the experimental observations. Extensive P_n and P_n^3 calculations were also conducted for neutron flux distortion and the disadvantage factor. In addition, the angular distribution shift effect was observed. (auth)

Theoretical Physics

4946 (AFOSR-1138) STOCHASTIC MODELS FOR MANY-BODY SYSTEMS. [PART] II. FINITE SYSTEMS AND STATISTICAL NON-EQUILIBRIUM. Robert H. Kraichnan (New York Univ., New York. Inst. of Mathematical Sciences). Aug. 1961. 89p. (HT-10)

Model Hamiltonians are developed for finite many-body Fermion or Boson systems that may be in statistical non-equilibrium. The Hamiltonians are stochastic in that they contain infinite numbers of random-phase parameters. The model developed yields formally summable propagator expansions for systems of any size. The non-equilibrium case is developed in the Heisenberg representation in such a way that unlinked diagrams do not arise. Evidence is presented that the derived Hamiltonians yield convergent results. The case is treated in which the particles in the system are of different species. (T.F.H.)

4947 (TID-14136) THE POSTULATES OF QUANTUM FIELD THEORY. R. Haag and B. Schroer (Illinois. Univ., Urbana). 1961. Contract [AT(11-1)-182]. 31p.

A survey was made of the postulates which provide the framework of quantum field theory. Particular attention was given to the less well known ones, namely completeness requirements and "primitive causality." Three field theoretical models were analyzed. These examples showed that "primitive causality" is not a consequence of the commonly used postulates (which include the "causal commutation relations"). "Asymptotic completeness" was not assured by any of the other postulates listed. In the formulation and analysis the concept of operator rings associated with space-time regions was used extensively. (auth)

4948 (TID-14357) A VARIATIONAL PRINCIPLE FOR POTENTIAL SCATTERING. G. H. Goedecke and E. Brown (Rensselaer Polytechnic Inst., Troy, N. Y.). [1961]. 37p. Contract AT(30-1)-1955.

Potential scattering is treated by a minimum variational principle. The method is applicable to problems that can be cast as linear inhomogeneous equations. The method makes use of a non-negative functional that reduces to zero for the exact solution. The magnitude of the functional for approximate solutions provides an indication of the accuracy of the wave function. The method is illustrated by examples, and compared with the Schwinger and Kohn principles. (auth)

4949 (UCRL-9922) GEOMETRIC FOUNDATIONS OF CONTINUUM MECHANICS. John A. Simmons (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1961. Contract W-7405-Eng-48. 100p.

The foundations of the geometry of a continuum approximation to the deformation of a crystalline solid were investigated. A method of formulating the infinitesimal deformation of a system of particles based on an averaging process was developed. This formulation was based on the construction of a "polyhedral mesh" valid for any system of particles whether or not they lie in a lattice configuration. However, when the particles lie in a perfect lattice, the mesh is shown to yield the familiar definition of dislocation motion. The averaging process was then extended to include deformations at grain boundaries. Using these results, the concept of infinitesimal plastic transformation was formulated and it is shown that by assuming the initial state of the material to be described by a spatial affine connection, the entire dynamic description of the material deformation is then given by a four dimensional space-time affine connection whose invariants together with the integrated strain define the state of the material. Equations of continuity for plastic as well as for ordinary elastic deformation were derived. The exterior calculus of E. Cartan was utilized to simplify the computations. (auth)

4950 ANTICOMMUTATOR FOR THE FIELD CORRESPONDING TO SPIN 3/2 ON AN EINSTEIN SPACE. André Lichnerowicz. Compt. rend., 253: 940-2(Aug. 7, 1961). (In French)

On an Einstein space a study was made, in Rarita-Schwinger formalism, of spinor propagators associated with a field corresponding to a spin 3/2. An anticommutator was constructed generalizing that of Takahashi and Umezawa. (tr-auth)

4951 ARE WAVE MECHANICS AND MATRIX MECHANICS EQUIVALENT THEORIES? N. R. Hanson (Indiana Univ., Bloomington). Czechoslov. J. Phys., B 11: 693-708(1961). (In English)

It is shown that the Eckart and Schroedinger proofs do not actually establish the equivalence of wave and matrix mechanics as physical theories. It is argued that it is impossible to prove that they are formally identical by assuming them to be within a more comprehensive theory. Furthermore, it cannot be proved that statement of wave mechanics can be converted into a corresponding statement of matrix mechanics using a "logical transformer" without theoretical content of its own. The convincing argument for equivalence as physical theories is provided by Born's statistical interpretation of the ψ function. (L.N.N.)

4952 ANALYTIC PROPERTIES OF THE THREE POINT FUNCTION. G. Bonnevay, I. J. R. Aitchison, and J. S. Dowker (The University, Birmingham, Eng.). Nuovo cimento (10), 21: 1001-11(Sept. 16, 1961). (In English)

For the vertex function in lowest order, the part of the Landau surface which is singular on the physical sheet is identified for the general case of three complex external masses. The result is extended for the seven other sheets obtained by crossing the normal (two-particle) branch cuts. Applications to production processes and reactions involving resonant or unstable states are indicated. (auth)

4953 UNCERTAIN SPACE-TIME-CONTINUUM, UNCERTAIN MASS, AND PAULI-VILLARS-REGULATION. G. Heber (Karl Marx Universität, Leipzig). Nuovo cimento (10), 21: 1045-57(Sept. 16, 1961). (In German)

It is shown that the field equations for a non-localizable, scalar field of mass zero have solutions the Green's functions of which are identical with the regularized functions of Pauli and Villars. The compensating masses have a physical meaning insofar as they correspond to the different possible masses of one particle with uncertain mass. It should be possible to create a convergent field theory by introducing an uncertain mass of the field particle or uncertain positions of the test bodies measuring the field. (auth)

4954 DEGREES OF GROWTH OF MATRIX ELEMENTS IN THE AXIOMATIC METHOD. B. V. Medvedev and M. K. Polivanov (Inst. of Mathematics, Academy of Sciences, USSR and Joint Inst. for Nuclear Research, Dubna, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1130-41 (Oct. 1961). (In Russian)

It is shown that very strong restrictions on degrees of growth of matrix elements arise in the axiomatic method of setting up the scattering matrix as supplemented by the requirement of renormalizability of the theory. (auth)

4955 ANALYTIC PROPERTIES OF THE SQUARE DIAGRAM WITH DECAY MASSES. V. N. Gribov, G. S. Danilov, and I. T. Dyatlov (Leningrad Inst. of Physics and Tech.). Zhur. Eksptl'. i Teoret Fiz., 41: 1215-20(Oct. 1961). (In Russian)

The analytic properties of the simplest square diagram of perturbation theory are investigated for the case when the masses of external particles do not satisfy the stability condition. (auth)

4956 ON THE SUPPOSED RELATION BETWEEN THE POLE POSITION AND RESIDUE IN THE POLE FOR THE SCATTERING AMPLITUDE. L. A. Khalfin (Inst. of Mathematics, Academy of Sciences, USSR). Zhur. Eksptl'. i Teoret. Fiz., 41: 1233-40(Oct. 1961). (In Russian)

It is investigated whether the dispersion relations can yield in principle a relation between the position of a pole and the residue in it, that is, between the mass and coupling constant. It is shown that the restrictions on possible values of the coupling constant are a consequence of the model treatment of examples considered. It is proven in the general case that if only the dispersion relations and unitarity conditions for the forward scattering amplitude are used as a starting point, no restrictions on values of the coupling constant will appear. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 4424 and 4615.

4957 (ANL-6466) EFFECT OF RESONANCE SCATTERING ON CRITICALITY CALCULATIONS OF FAST ASSEMBLIES. D. Meneghetti (Argonne National Lab., Ill.). Dec. 1961. Contract W-31-109-Eng-38. 13p.

Critical masses of representative ZPR-III fast assemblies containing resonance scatterers are calculated using the SNG transport code. THE IBM-704 ELMOE code of Hummel and Rago was used to evaluate group transport and group elastic-transfer cross sections in the cores in conjunction with the 16-group cross section set of Yiftah, Okrent, and Moldauer. By using hundreds of neutron energy groups and the detailed elastic scattering matrices for the resonance scatterers, ELMOE carries out a fundamental mode analysis. It thereby obtains material buckling and the detailed fine structure flux dependence upon energy. It then re-evaluates the gross group cross sections for transport and elastic transfer. Consideration of the resonance scattering effects caused by aluminum and stainless steel increase the calculated critical masses of ZPR-III assemblies 23, 31, and 32 by about 15 kg, 21 kg, and 21 kg, respectively. Corresponding reactivity decreases are about −1%, −0.7%, and −2% $k_{effective}$, respectively. (auth)

4958 (ANL-6468) AN EXPERIMENTAL INVESTIGATION OF SOME SOURCES OF ERROR IN THE MEASUREMENT OF ABSOLUTE FISSION RATIOS IN FAST REACTORS. W. G. Davey and R. N. Curran (Argonne National Lab., Idaho Falls, Idaho). Nov. 1961. Contract W-31-109-eng-38. 8p.

Measurements in AFSR of the changes in some fission ratios which result from the proximity of relatively small quantities of steel and polyethylene are described. The results show that some of the measurements with the Kirn absolute fission chambers in ZPR III are probably in error by several percent. (auth)

4959 (ANL-6473) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, NOVEMBER 1961. (Argonne National Lab., Ill.). Dec. 15, 1961. Contract W-31-109-eng-38. 69p.

Progress is reported on EBWR, BORAX-V, sodium-cooled reactors, EBR-I, EBR-II, reactor safety experiments, applied nuclear physics, reactor fuels development, reactor materials development, heat engineering, separations processes, and advanced reactor concepts. (M.C.G.)

4960 (APDA-145) CONCEPTUAL DESIGN OF AN IN-PILE PACKAGE LOOP FOR SODIUM-COOLED THERMAL REACTOR FUEL TESTING. (Atomic Power Development Associates, Inc., Detroit). Sept. 15, 1961. Contract AT(11-1)-865. 75p.

Results of a conceptual design study are presented concerning a facility for testing Na-cooled thermal reactor fuel assemblies in the Advanced Test Reactor. The results indicate that such a test facility is feasible for use in tests of ceramic, cermet and metallic fuel specimens. Major design and performance objectives are tabulated and described. (J.R.D.)

4961 (BMI-1554) PROGRESS ON THE DEVELOPMENT OF URANIUM CARBIDE-TYPE FUELS. Final Report on the AEC Fuel-Cycle Program. Frank A. Rough and Walston Chubb, eds. (Battelle Memorial Inst., Columbus, Ohio). Nov. 17, 1961. Contract W-7405-eng-92. 58p.

A $2\frac{1}{2}$-year study of uranium monocarbide is concluded. The skull arc-melting equipment and process were developed to produce 6-kg castings with a carbon content predictable within ±0.05 wt %. The preparation of a homogeneous skull is important in obtaining this control, and may be accomplished by melting pre-alloyed uranium carbide in a water-cooled copper crucible. Once a homogeneous skull is prepared, this compositional control can be maintained even with elemental charges. Erosion of the graphite electrode is minimized by using outgassed TSF graphite and is compensated for by adding small amounts of elemental uranium. The highest quality material is produced by vacuum melting and casting procedures. Hot hardness, dilation, and resistivity measurements to about 1600°C were performed. A change in state of UC_2 at about 870°C was indicated. As-cast mixtures of UC and UC_2 containing 7.0 wt % carbon were found to transform to U_2C_3 on reheating by a sluggish reaction between 1100 and 1700°C. Rates of self-diffusion of carbon in uranium monocarbide were about 1000 times the rates of self-diffusion of uranium in uranium monocarbide between 1200 and 2200°C. Below 700°C, uranium monocarbide showed no gross dimensional changes as a function of irradiation to a burnup of 0.7 at.% of the uranium. Resistivity and lattice strain of uranium monocarbide showed significant changes at a burnup of only 0.004 at.% of the uranium. No further significant change occurred as a function of additional burnup. A portion of this effect was annealed out in irradiation at 700°C. Uranium sesquicarbide showed no gross dimensional changes under irradiation to a burnup of 0.56 at.% of the uranium at about 700°C. Metastable uranium dicarbide structures which began to precipitate graphite were not compatible with NaK. (auth)

4962 (DL-45) BEHAVIOUR OF FISSION GASES IN UO_2 FUEL. W. B. Lewis (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1961. 39p. (AECL-1402)

The pressure that may be exerted by fission gases that escape from sintered UO_2 fuel was evaluated. The mechanisms causing migration of fission product gases are reviewed. Mechanisms leading to escape from the solid include concentration gradient diffusion, gross plastic deformation (squeezing), grain growth, stoichiometric changes of oxygen bonding, vaporization including that causing void migration, fission recoil, and knock-out by fission fragment impact. Effective trapping results from migration to closed pores; some experimental studies by subsequent grinding are reviewed. Re-entry of the gas into the solid oxide was also established and is significant at pressures of tens of atmospheres. A remarkable disproportioning of the isotopes of natural xenon trapped in the oxide was discovered. It appeared that the disproportioning occurs before the trapping. Possible mechanisms for the disproportioning and trapping are discussed. Some experimental results on measured gas release are given. (auth)

4963 (EXP-NRX-6304) RADIOCHEMISTRY OF DEFECT TEST ON HIGHLY RATED UO_2 FUEL TEST X-2-y. G. M. Allison and I. H. Crocker (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1961. 30p. (AECL-1339)

Radiochemical results obtained during a three week irradiation of a defected, highly rated UO_2 fuel specimen in the X-2 loop are given. Escape-rate coefficients calculated for the fission-product gases Kr^{88} and Xe^{138} are similar to those found in previous defect tests X-2-s and

X-2-q. The release of the radioiodines was lower than in previous tests. The D.N. and gamma monitors indicated an increase in activity with reactor power cycles of ~10 Mw occurred. The increase was more pronounced on the power rise. (auth)

4964 (GAMD-1179) PRELIMINARY EXPERIMENTAL STUDY OF STRONTIUM VAPORIZATION, CONDENSATION, AND AEROSOL FORMATION FOR HTGR SAFETY ANALYSIS. C. Milstead, A. Riedinger, and L. Zumwalt (General Atomic Div. General Dynamics Corp., San Diego, Calif.). Jan. 27, 1960. Contract AT-(04-3)-314. 8p.

An analysis of an accident resulting in the loss of HTGR He coolant pressure is presented. It is noted that in such accidents the metal-clad HTGR fuel elements would be expected to burst and release vaporous fission product elements at core operating temperature. In the analysis, Sr^{90} is used experimentally since it is considered one of the most hazardous. It is concluded from analysis of the data that very little Sr^{90} aerosol with micron or submicron particles will form and that the element will condense on cool surfaces or can be filtered out. (J.R.D.)

4965 (GAMD-1250) SOME ASPECTS OF THERMAL MIGRATION IN THE HTGR FUEL ELEMENT. H. K. Lonsdale (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 18, 1960. Contract AT(04-3)-314. 16p.

Experiments indicated that severe unmixing of uranium–thorium and graphite can be brought about by thermal gradients at high temperatures. Possible mechanisms for this unmixing are discussed, predictions are made for the steady state configuration of the fuel element when subjected to a temperature gradient, and a few experiments are suggested to help elucidate the transport mechanism. The sample test was a cylindrical rod with a graphite matrix containing uniformly dispersed, fine particles of UC_2 and ThC_2. The rod was resistance heated and due to radiation losses at the surface a radial temperature gradient was established. It was concluded that the transport mechanism could be any of the following, depending on the state of the system: "chemical potential" diffusion over the surface of the graphite particles, a vapor phase transport, or bulk thermal diffusion. The first was considered most likely. (M.C.G.)

4966 (HW-70315) EROSION RESISTANCE OF SWAGED UO_2 FOLLOWING AN IN-REACTOR FUEL ROD CLADDING FAILURE. M. K. Millhollen, G. R. Horn, and J. L. Bates (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 1961. Contract AT(45-1)-1350. 15p.

During a routine irradiation of a swaged UO_2, 19-rod cluster fuel element (GEH-12-4) in an ETR facility, an unpremeditated cladding split occurred in one fuel rod. The failure occurred during the 24th day of full power operation at a maximum surface heat flux of ~600,000 Btu/(hr)(sq ft). Inspection of the 1.5 in. long split revealed that a maximum of 10% of the exposed, sintered UO_2 was eroded. This finding was particularly significant since the reactor was operated at full power for 15 hours after the defect was detected. Examination also revealed that no structural weakness, distortion, or corrosion was evident in the fuel rod bundle. (auth)

4967 (HW-SA-2012) ON THE INSTABILITY OF SOLUTIONS OF THE REACTOR KINETIC EQUATIONS WITH SINUSOIDALLY VARYING REACTIVITY. A. L. Ruiz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 25, 1960. Contract AT(45-1)-1350. 19p.

It is shown that solutions of the reactor kinetic equations with sinusoidally varying reactivity are always unstable for all values of amplitude and frequency of oscillation and for all values of reactor parameters. (auth)

4968 (IDO-16607(Add.)) ENGINEERING TEST REACTOR CRITICAL FACILITY CONTROL SYSTEM MANUAL. F. A. Meichle (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 28, 1961. Contract AT(10-1)-205. 76p.

The electrical services, trouble shooting check out lists, control relay wiring, terminal and plug connections of the Engineering Test Reactor Critical Facility are presented. Information for maintenance and modifications are also provided. (M.C.G.)

4969 (IDO-16709) MEASUREMENT OF REACTIVITY IN THERMAL REACTORS. H. L. McMurry and D. R. Metcalf (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Feb. 29, 1960. Contract AT(10-1)-205. 25p.

The equations used as the basis for computing reactivities from experimental data when fissioning is mainly by thermal neutrons are shown. The conditions are reviewed under which an asymptotic period given by the inhour equation will be obtained. The reactivity and the period are usually associated with a reactor which can be brought to criticality by the addition of distributed poison. Some origins of equations relating reactivity to this poison distribution are sketched. The equation derived using adjoint functions had the soundest theoretical basis. However it involves parameters not usually measured. When fuel is distributed non-uniformly the correct theory suggests that the poison should be distributed in proportion to the macroscopic thermal cross section in the core. (M.C.G.)

4970 (MND-MD-2540) PM DEVELOPMENT PROGRAM, TASK 5.0, HEAT TRANSFER TESTS. LOCAL BOILING BURNOUT EXPERIMENTS ON TUBES WITH INSIDE AND OUTSIDE FLOW. J. J. Jicha and S. Frank (Martin Co. Nuclear Div., Baltimore). Nov. 1961. Contract AT(30-1)-2706. 92p.

Local boiling burnout data were obtained over a range of parameters of interest for the PM-1 reactor core. The program was conducted with a single-tube test section having coolant flow both inside and outside the tube, thus providing a good simulation of the pertinent heat transfer and hydrodynamic characteristics of the PM-1 fuel element. The test section, which was designed to achieve high subcoolings and maximum heat flux with the available power supply, required some dimensional changes relative to a PM-1 element. The dimensions of the stainless steel, heated tube were: 0.457-inch outside diameter, 0.416-inch inside diameter, 0.0205-inch wall thickness and 15-inch length; a 4-inch nickel extension was brazed to the outlet end. The outer diameter of the annular flow path was 0.688 inch. Burnout conditions for the bulk of the program were approached by increasing the power at constant inlet temperature (subcooling), pressure and flow rate until departure from nucleate boiling (DNB) was experienced. DNB was determined by a burnout detector, which responded to the small change in the test section electrical resistance experienced at the initiation of partial film boiling. Physical burnout runs and runs in which burnout was approached by decreasing the bulk coolant subcooling were also designed into the 149-run program to provide a check on the burnout detector operation. The test results, when reduced to obtain inside and outside burnout heat fluxes, showed reasonably good agreement with the Griffith correlation. This relationship is recommended for

use in reactor design studies in the local boiling region of operation. However, in contrast to the Griffith correlation, the data of this study show little or no dependence on the coolant subcooling. This is believed to be a direct result of the two paths available for heat flow from the tube. The total burnout heat flux (total power divided by inside plus outside surface area) was successfully correlated using either the inside or the outside mass velocity as the only independent variable. The dependence on mass velocity agrees closely with that expressed by the Jens and Lottes burnout correlation. Additional burnout studies are recommended to establish the effect of flow split on the burnout heat flux over the complete range from equal inside and outside flow to zero flow on either side. The pertinent features of a test section design which has the capabilities of providing this data are described. (auth)

4971 (NAA-SR-3829(Suppl.1)) TRANSIENT BEHAVIOR OF AN ADVANCED SODIUM GRAPHITE REACTOR. H. H. Cappel (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-Gen-8. 55p.

An analysis of the transient behavior of a 255-Mw(e) advanced sodium graphite reactor, previously described in NAA-SR-3829, is presented. The reactor and its components are briefly described. Nuclear and thermal characteristics are presented as far as they affect reactor kinetics or are essential in interpreting the results. The study includes an investigation of the inherent kinetic characteristics of the reactor, as well as an analysis of its transient behavior for all conceivable conditions of abnormal operations. Assumed reactor excursions are analyzed with and without ensuing protective system action. It is shown that the reactor is dynamically stable and that power transients which are followed by normal protective system actions will not lead to potentially unsafe conditions. The conclusion is reached furthermore, that uncontrolled rod withdrawal accidents from source power will be terminated by coolant "choking" and fuel meltdown before extensive coolant boiling occurs, and that the large thermal capacity and long-time constant of the upper plenum will provide protection against pool boiling for other less serious accidents until the reactor can be shut down by external means. (auth)

4972 (NAA-SR-5049) RADIOISOTOPIC INVESTIGATION OF OMR COOLANTS. PART I. OMRE OPERATION, JANUARY 1958–AUGUST 1960. L. Baurmash, S. J. Wode, and D. C. Lawrence (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-GEN-8. 24p.

Over 30 radioisotopes were identified in the coolant of the OMRE during the period from January, 1958 through August, 1960. The principal gamma-emitting isotopes measured were the corrosion products: Mn^{56}, Fe^{59}, and Mn^{54}; the principal beta emitters were: P^{32}, H^3, S^{35}, Fe^{55}, and C^{14}. The total (gamma plus beta) activity of the coolant during normal reactor operations was estimated to have been less than 1.08 μc/gm of coolant, with Mn^{56} contributing approximately 80% of the detected process radiation. (auth)

4973 (NAA-SR-6357) ISOTHERMAL TEMPERATURE COEFFICIENT FOR THE SRE WITH THORIUM–URANIUM FUEL. R. A. Lewis (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-GEN-8. 13p.

A measurement of the isothermal temperature coefficient of reactivity was made for the Th–U fuel loading of the SRE. It was found to be 0.33 cents/F° at 350°F and 0.12 cents/F° at 710°F. The uncertainty in the results is approximately ±0.01 cents/F°. (auth)

4974 (NAA-SR-6359) SRE CORE RECOVERY PROGRAM. W. J. Freede (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1961. Contract AT(11-1)-Gen-8. 112p.

During an experimental nuclear power run at the Sodium Reactor Experiment (SRE), a leak occurred which allowed from 2 to 10 gal of organic material, commercially known as tetralin, to enter and decompose in the reactor core. Carbonaceous residue products reduced the sodium coolant flow in fuel channels to such an extent that 13 out of 43 fuel elements were damaged. A substantial quantity of special equipment was developed, tested, and utilized to assess the situation, remove 81 loose fuel slugs plus other debris from the reactor core, and replace 16 moderator cans, 12 of which contained portions of fuel elements. On-site recovery operations were safely and successfully performed by SRE operating and maintenance personnel. Work progressed 24 hours per day with the crews following a rotating schedule. In no instance did radiation exposure exceed standard AEC tolerances. On the average, exposure was less than a third of this tolerance. (auth)

4975 (NAA-SR-Memo-865(Rev.)) FLUX DISTRIBUTIONS AND LEAKAGE CURRENTS FOR SRE, P-16. R. Balent (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 29, 1954. Decl. Sept. 7, 1961. Contract [AT(11-1)-Gen-8]. 4p.

Two-group, two-region criticality calculations were made for 10 and 11 ft diameter tanks. The 10 ft tank required a core radius of 102 cm and the 11 ft tank a core radius of 95 cm for criticality. In the calculations, the fluxes were assumed to go to zero at the edge of the graphite reflector. The fast group of the two-group calculation was broken down into 3 fast groups. The leakage out of the core and reflector for the 4 energy groups is given. (M.C.G.)

4976 (NAA-SR-Memo-5265) FUEL HANDLING THERMAL ANALYSIS FOR 18-ROD HNPF U-10 MOLY FUEL ELEMENTS. J. K. Imig (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 13, 1960. Contract [AT(11-1)-Gen-8]. 17p.

The maximum fuel element temperatures were determined as a function of decay time for the various fuel element locations that may occur during fuel handling operations. Decay times required to prevent the fuel element temperatures from exceeding 1472°F were determined for all possible locations and for normal locations. (D.L.C.)

4977 (NAA-SR-Memo-6640) CALCULATION OF CONTROL ROD WORTH. H. Rood (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 8, 1961. Contract [AT(11-1)-Gen-8]. 15p.

An examination and comparison was made of the accuracy, ease of utilization, and availability of various analytical techniques and machine codes used to calculate control rod worth. Special attention is given to cylindrical control rods, such as are used in the POPR. The general approach selected is few-group diffusion theory with blackness theory boundary conditions. Several specific problem areas associated with this method are investigated: methods of determining boundary conditions to apply at the control rod surface; methods of averaging boundary conditions over an epithermal energy group; and the effects of the curvature of the rod surface on the boundary conditions to be applied at the rod surface. The results of the investigations are used to select a consistent technique for calculating the worth of cylindrical control rods. The accuracy

of the technique is compared with that of other methods. The selected technique is then used to determine that the POPR control rods are worth 20% Δk/k. (auth)

4978 (NP-10731) IL CONTRIBUTO DEL CNEN ALLE GIORNATE DELL'ENERGIA NUCLEARE (MILANO 16-18 DICEMBRE 1960). The Contribution of the CNEN to Date to Nuclear Energy (Milan, December 16-18, 1960)). Italy. Comitato Nazionale per l'Energia Nucleare, Rome). 1961. 193p.

Ten papers are included; separate abstracts have been prepared for six. The four papers not abstracted are general discussions of the CNEN organic reactor program, the Montecuccolino research program, high-temperature gas cooled reactors, and Italian laws on transporting radioactive materials. (J.S.R.)

4979 (NP-10731(p.33-57)) CARATTERISTICHE FISICHE ED ECONOMICHE DEL CICLO Th–U IN UN REATTORE AD ACQUA BOLLENTE. (Physical and Economic Characteristics of the Th–U Cycle in a Boiling Water Reactor). C. Basso, V. Benzi, P. Loizzo, S. Pittori, S. Russo, G. Solinas, and C. Vallone (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

The technical possibilities and the economic characteristics of the Th–U^{233} cycle in a boiling water reactor are presented. The reactor considered is a BWR reactor with characteristics very similar to the SENN Reactor. In the study the slightly enriched uranium oxide core is replaced with a geometrically identical core using a mixture of the oxides of thorium and uranium-235. In the first part the core characteristics with respect to uranium and the theoretical schemes used for the nuclear calculations are given. The two cycles are compared. In the second part an economic analysis is made varying the cost of fabrication, chemical treatment, and price of the U^{233} produced. (tr-auth)

4980 (NP-10731(p.58-96)) NUOVI CIRCUITI PER LA SIMULAZIONE DI REATTORI NUCLEARI. (New Circuits for the Simulation of Nuclear Reactors). G. Ambrosini, S. Barabaschi, L. Gentilini, and A. Mathis (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

Some studies made on the simulation of the thermal part of a nuclear reactor are reported. In the first part a new simulation method adapted to the case where the power initiated in the coolant can be considered uniform in space is described. A simulation scheme which takes into account the thermal capacity of the fuel but which does not permit, in the form proposed, the study of transients with variable coolant flow is then discussed. In the third part a special element with which it is possible to obtain a very accurate simulation of the channel of a reactor is reviewed. Some of the transients obtained from various circuits proposed with those obtained from classical circuits are analyzed and compared. (J.S.R.)

4981 (NP-10731(p.97-125)) IL SISTEMA DI REGOLAZIONE DEL REATTORE ISPRA-I. (The Control System for the Ispra-I Reactor). S. Barabaschi and A. Pulacci (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

The Ispra-I Reactor of a modified CP-5 type, cooled and moderated with heavy water, is used as a neutron source for physics and nuclear engineering studies. Some modifications made to the control system are reviewed, with particular emphasis on the alternate operation of two channels compared with the parallel operation of the original system. One of the channels is of the continuous type with dead zone and the other is of the discontinuous type. (J.S.R.)

4982 (NP-10731(p.126-8)) SERVOMOLTIPLICATORE CAMPIONATO AD ALTA VELOCITÀ AD ALTA PRECISIONE. (Servomultiplier Designed for High Velocity and Precision). Sergio Barabaschi and Renzo Tasselli (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

The characteristics of a high velocity, high precision servomultiplier are briefly reviewed, and the means of removing the principal causes of error are indicated. The design of an experimental servomultiplier using these principles is briefly described. (J.S.R.)

4983 (NP-10731(p.129-44)) ANDAMENTO DELLA RADIOATTIVITÀ ARTIFICIALE NEGLI ANNI 1958-1959-1960 E SUE RIPERCUSSIONI SULLA CATENA ALIMENTARE. (Behavior of Artificial Radioactivity in the Years 1958-1959-1960 and Its Effects on the Food Chains). A. Malvicini (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

The systematic measurement of the radioactivity of the air and of fall-out was initiated at Ispra in February 1958. During the year 1959 methods were developed for the measurement of radioactivity in milk, soil, vegetables, and animal bones. During 1960 these measurements were continued, and also the radioactivity of samples of sea and fresh water was measured. Graphs and tables of the results obtained are given. (J.S.R.)

4984 (NP-10731(p.145-68)) VALUTAZIONE DELL'INCIDENTE DOVUTO AD UNA ROTTURA NELLO SCAMBIATORE DI CALORE IN UN REATTORE AD ORGANICO. (Evaluation of an Incident Due to a Break in the Heat Exchanger of an Organic Reactor). E. Merli (Italy. Comitato Nazionale per l'Energia Nucleare, Rome).

A quantitative evaluation of the results of water from the secondary circuit coming in contact with the organic fluid of the primary circuit is given. The incident considered is a leak in the evaporator, a leak which lets water into the primary circuit and causes an increase of the pressure. The pressure variation in the primary as a result of the water contact with the organic liquid and dependence of the pressure variation on the free volume are estimated. (J.S.R.)

4985 (NUMEC-P-80) DEVELOPMENT OF PLUTONIUM BEARING FUEL MATERIALS. Progress Report for period July 1 through September 30, 1961. (Nuclear Materials and Equipment Corp., Apollo, Penna.). Contract AT (30-1)-2389. 55p.

Data are tabulated for the characteristic parameters of PuO_2 powders prepared by the continuous oxalate precipitation process. The results show that the PuO_2 surface area decreases almost linearly with calcination hold times at 760°C. A thermogravimetric study of the decomposition of Pu oxalate indicate the formation of an initial stable compound at ~100°C and a stable intermediate at ~300°C. Characteristic data are tabulated for UO_2–5% PuO_2 and UO_2–20% PuO_2 powders prepared by coprecipitation. Preliminary blending studies giving a final UO_2–0.5% PuO_2 powder show that a more homogeneous product is obtained if two powders of the same surface area are used. Results are given for preliminary studies of the direct preparation of high-density coarse particles. A study was made of the simultaneous determination of Pu and U by differential spectrophotometry. Sintering studies were made on PuO_2 and on both mechanically mixed and coprecipitated PuO_2–UO_2; the results indicate that the blending and mixing procedures are unsatisfactory. The eutectoid-like microstructure observed in sintered PuO_2 pellets appear to be Pu_2O_3. Preliminary preparations of sintered PuO_2 spheres coated with Ni are reported. (D.L.C.)

4986 (NYO-2687) NUCLEAR FUEL RESEARCH, FUEL CYCLE DEVELOPMENT PROGRAM. Quarterly Progress Report, January 1–March 31, 1960. (Olin Mathieson Chemical Corp. Metallurgical Labs., New Haven). Apr. 15, 1960. Contract AT(30-1)-2374. 28p.

Uranium Oxide Fuel. An investigation was conducted of the effect of furnace atmosphere composition on the sintering properties of non-stoichiometric UO_2. The results of sintering experiments at 1250 and 1300°C with soaking times from 5 to 12 hr show that the H_2 throughput must be very low to prevent premature removal of excess O_2. This necessitates comparatively long soaking periods which are uneconomical, and two alternative methods with short sintering cycles are proposed. Uranium Carbide Fuel. Thermodynamical calculations were made for the stabilities of U, UC, and UC_2 in the U hydride-CH_4 reaction as a function of temperature. The results indicate that UC at 600°C should decompose to UC_2 + U, which is contrary to experimental observations. An experimental study of the U hydride-CH_4 reaction at 600 to 700°C indicates that H_2 mixed with the CH_4 has no significant effect on the resulting UC, and that the optimum reaction temperature is between 650 and 700°C. Compacting studies of the powders produced in this reaction show that UC containing some U has a higher sintered density than either pure UC or UC + UC_2. A furnace for consumable arc melting and fabrication of UC electrodes for use therein are discussed. (D.L.C.)

4987 (ORNL-TM-26) A SIMULATION OF THE EGCR STEAM GENERATOR. M. M. Yarosh and S. J. Ball (Oak Ridge National Lab., Tenn.). Oct. 1961. Contract W-7405-Eng-26. 99p.

An analog model of the EGCR steam generator was developed and operated on the ORNL analog computer as part of a program to simulate the operation and control of the EGCR reactor plant. Equilibrium operation and the transient response of the steam generator unit to system perturbations were studied. A simultaneous solution of the basic heat transfer equations representing the performance of the unit was obtained. The model was operated initially at steady-state conditions, and then perturbations were made to gas flow, gas inlet temperature, and steam throttle valve position. The response characteristics of the model during the transients were recorded. The steam generator gas outlet temperature showed a marked degree of insensitivity to changes in gas inlet temperature. The effect of gas flow changes on gas exit temperature was slightly more pronounced. The transient behavior of the unit was reasonable, and the model developed indicated satisfactory operation within the design range of 20 to 100% of full power. (auth)

4988 (ORNL-TM-42) SUMMARY OF HRT RUN 21. P. N. Haubenreich, H. F. Bauman, N. C. Bradley, J. R. Engel, J. O. Kolb, H. B. Piper, and D. M. Richardson (Oak Ridge National Lab., Tenn.). Oct. 10, 1961. Contract [W-7405-Eng-26]. 63p.

The HRT was operated experimentally during run 21 at powers up to 5 Mw to explore the limiting conditions of fuel stability and to demonstrate the reliability of the system. The effect of core pressure on fuel stability was investigated over the range from 1250 to 1750 psig. Stable operation at 5 Mw (2.6 Mw in the core) was demonstrated at 1250 psig. At 1600 and 1750 psig, fuel instability accompanied by rapid loss of reactivity occurred at powers down to 2.5 Mw. The threshold power for reactivity loss at intermediate pressures was raised by increasing the fuel acid/sulfate ratio from 0.28 to 0.34. In other studies the fuel temperature was varied from 240 to 275°C at several different pressures. In some instances the reactor appeared more stable at the lower temperatures. The effects of suspended solids and oxygen concentration were examined briefly without conclusive results. At times during operation at low pressure and high power, an increase in reactivity, indicating deposition of uranium on the core tank, was observed. During an experiment to investigate this effect, a hole was melted in the core near the equator. The reactor was shut down for examination and modifications to improve the core hydrodynamics. Experiments on internal recombination showed solution recombination-rate constants significantly higher than were previously measured in out-of-pile experiments. Equipment performance was generally satisfactory. A diaphragm failure in one head of the fuel feed pump, minor leakage through four valves, low efficiency of the low-pressure recombiners and rupture of the air-cooled condenser by freezing were the principal difficulties. There was one period of 105 days of continuous operation. During run 21 operations, which extended from October 4, 1959, to January 23, 1960, the reactor was critical for 2455 hours and produced 5598 Mwh(th). (auth)

4989 (ORNL-TM-66) BUILDUP OF FISSION PRODUCTS IN REACTOR FUEL AND COOLANT WITH 'UNCLAD' FUEL MATERIAL. William B. Cottrell and L. A. Mann (Oak Ridge National Lab., Tenn.). Oct. 18, 1961. Contract [W-7405-Eng-26]. 81p.

Concentrations of fission products in the fuel and in the coolant stream of a generalized reactor power plant employing unclad fuel material were calculated using actual fission-product chains and wide ranges of assumed values of escape rate from the fuel and removal rate from the coolant stream. The calculations were made on an IBM 704 digital computer. Some typical results are displayed in the form of graphs to illustrate the effects of the variables. As data on escape rates from fuel and removal rates from coolant become available, the tables and graphs developed by this study can be used to estimate the fission-product concentration in the coolant stream, which would in turn furnish a basis for determining the degree of coolant purification required to maintain the circulating activity below a given level. (auth)

4990 (JPRS-10815) AN INVESTIGATION OF THE SYSTEM OF AUTOMATICALLY RELATING THE POWER LEVEL OF A NUCLEAR REACTOR. A. V. Bondarenko, Yu. A. Voznesenskiz, M. E. Minashin, I. I. Sidorova, and V. N. Sharaprov. Translated from Inzhener.-Fiz. Zhur., Akad. Nauk Belorus. S.S.R., 4: No. 8, 57-62(Aug. 1961). 19p.

A discussion is given of the formulation and analysis of a system of equations for the transient processes for a boiling heterogeneous uranium–graphite fueled reactor, having an automatic power level regulation system. Questions considered in conjunction with the work of the automatic regulator and the reactor in the transient state include: accuracy estimate of representing the reactor as a model having one group of delayed neutrons; determination of the quality of regulation as a function of the change of parameters of the regulation system; determination of the allowable jumps of reactivity which the regulation system can handle; investigation of the work of the regulation system under reactive pulses; and investigation of the effects of pulsations of the dispersion of the coolant on the change of reactor power. (B.O.G.)

4991 NEW METHODS FOR THE CALCULATION OF BURN-UP IN REACTORS. E. Kern (BBC-Krupp, Mannheim, Ger.). Atomkernenergie, 6: 337-44(Sept. 1961). (In German)

When calculating the burn-up one generally applies rough approximations, e.g., by calculating the time-dependent decrease of the reactivity of a fuel system under the provision of a neutron flux constant with regard to space and time and a space constant fuel distribution, disregarding the criticality conditions for the reactor. In the present article the burn-up is calculated in another way than in the above method, i.e., the calculation of burn-up under consideration of the flux dependence and the variation of the distribution of concentration of the fuel components by solving at any time the boundary problem, which represents the criticality of the reactor. To simplify the formalism, the fuel charging is assumed in such a way that the fresh fuel is continually piled up from the top on a (vertical) cylindrical core (with reflector). The core height thus increases monotonously with time. The burn-up can be calculated in a relatively simple way by representing the fuel charging as above in a simplified manner. This method of treating the problem can be taken as a simplified model for the complicated case of burn-up control by control rods. Apart from the quantitative values of fuel required, the calculation of burn-up gives the concentration of the individual fuel components in dependence of height z within the core (depending upon the method of solution whether the radial dependence is taken into account or not) and of time t and the flux distribution over z in dependence of t. It gives especially the direct or indirect values: burn-up of the uranium, quantity of bred fission materials (conversion), and poisoning by fission products. In connection with a perturbation calculation, the temperature coefficient of the reactor can be calculated in dependence of the operating time t. In view of a practical application of the formalism, formulas are derived to treat this problem with an analog computer. The problem is characterized by solving a partial differential equation (with integral additional condition) representing a boundary problem with nonconstant boundaries. The formalism is applied to the example of the BBC-Krupp pebble-bed reactor. The charging with fuel balls in this reactor corresponds to the above described simplified charging mechanism. Apart from this kind of charging, in which case the core height increases with time, another method of fuel charging at a given constant core height is treated, where simultaneously with the charging of fresh fuel from the top the same quantity of burned-up fuel is discharged at the bottom of the core. This case is analogous to that of a reactor with fixed fuel elements, where at one side of the core fresh elements are inserted and burned-up elements are removed correspondingly at the other side of the core. Similar modifications of the formalism as to other specific methods of fuel charging are possible without difficulties. (auth)

4992 SHIELDING CALCULATIONS FOR A BOILING WATER REACTOR. H. G. Fendler, H. Preusch, and L. Sellen. Atomkernenergie, 6: 353-9(Sept. 1961). (In German)

Shielding calculations for neutrons (fission neutrons and thermal neutrons) are described in a two-group program, but for gamma radiation ten energy groups are used. These calculations were carried out for the determination of shielding a boiling water reactor with approximately 60 Mw(t). The flux distributions were calculated for different combinations. Graphic figures of these fluxes are shown and discussed. (auth)

4993 NON-STATIONARY TEMPERATURE DISTRIBUTION IN PLATE AND CYLINDRICAL FUEL ELEMENTS AFTER SHUT-DOWN OF THE REACTOR. L. Boeswirth. Atomkernenergie, 6: 360-3(Sept. 1961). (In German)

The nonstationary temperature distribution in cylindrical and plate-type fuel elements following a shut-down of the reactor (sudden disappearance of the heat sources) is treated with the Galerkin approximation method. An example is given and the result was compared with a numerical solution found by the method of differences. Formulas for the heat stored in the fuel element and for the time-dependent heat flux are derived. A simple representation of the stationary temperature distribution is possible for two kinds of materials with characteristic temperature dependence of thermal conductivity (metallic uranium, uranium dioxide). This is used together with Galerkin's method to find an approximation for the nonstationary temperatures. (auth)

4994 NON-FERROUS METALS AS CONSTRUCTIONAL MATERIALS IN A REACTOR. [PART] II. E. Gebhardt. Atomwirtschaft, 6: 545-50(Nov. 1961). (In German)

The contribution gives a general review of the characteristic properties of non-ferrous metals which are of significance as constructional materials in reactor building. (auth)

4995 THE COUNTER CHANNEL IN REACTORS. J. Schmidl (Siemens & Halske A. G., Karlsruhe, Ger.). Atomwirtschaft, 6: 550-4(Nov. 1961). (In German)

The instrumentation of a starting channel consisting of a BF_3 counter, preamplifier, main amplifier, discriminator, mean value meter, and differentiator is described with special attention to circuit and structural measures against disturbing influences. (auth)

4996 THE FOKKER–PLANCK EQUATION AND THE AUTOCORRELATION FUNCTION OF NUCLEAR REACTORS. Augustin Blaquière, Jean Cazemajou, Georges Lapicque, Roza Pachowska, Thomas Stern, and Jean Valat. Compt. rend., 253: 2226-8(Nov. 13, 1961). (In French)

The Fokker-Planck method of calculating the mean square of the statistical fluctuations of the number of neutrons in a pile is extended to show that it also delivers the correlation function of the noise N(t). In order to simplify the description, the slow neutrons are neglected. (P.C.H.)

4997 EXPERIMENTAL STUDY OF FINNED CANS OF THE 'HERRING-BONE' TYPE. J. P. Milliat (Electricité de France, Chatou). J. Brit. Nuclear Energy Conf., 6: 337-41(Oct. 1961).

Results of thermal tests on finned cans of the herring-bone type are reported. These cans are divided longitudinally into an even number of sectors, each sector being fitted with spiral fins of identical pitch and the fins of two adjacent sectors having opposite pitch. Only the aerodynamic and thermodynamic performances are considered. Although general conclusions cannot be made, the performance of this can appears to be comparable to that of polyzonal cans having similar geometrical characteristics. (L.N.N.)

4998 DEVELOPMENT OF THE POLYZONAL SPIRAL FUEL ELEMENT. H. L. Ritz (C. A. Parsons and Co. Ltd., Newcastle-upon-Tyne, Eng.). J. Brit. Nuclear Energy Conf., 6: 342-7(Oct. 1961).

Research and development work in relation to the polyzonal spiral principle are outlined. Starting with the results obtained during the examination of the heat transfer and flow mechanism, the progress made in the over-all performance of the fuel elements of the original configuration is described. Limitations are indicated and modifica-

tions suitable for higher fuel ratings and gas temperatures, together with features of two resulting variations of polyzonal spiral elements, are described. (auth)

4999 REACTIVITY MEASUREMENTS–PROBLEMS, METHODS, AND APPLICATION POSSIBILITIES (SUMMARY REPORT). P. Liewers (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 593-618(Aug. 1961). (In German)

In this survey report on reactivity measurements, the kinetic behavior of a reactor is first considered, then the methods used for the measurement of the reactivity are reviewed. The application possibilities discussed are measurement of physical properties, static reactor parameters, kinetic reactor parameters, dynamic reactor parameters, and parameters which are necessary for the operation of the reactor. (J.S.R.)

5000 INSTRUMENTATION OF FAST REACTORS. J. L. Phillips (Dounreay Experiment Reactor Establishment, Caithness, Scotland). New Scientist, 11: 470-3(Aug. 24, 1961).

Fast reactor instrumentation is surveyed. The main items requiring measurement are considered and the principles adopted are outlined with reference to the Dounreay Fast Reactor as a typical example of the applications. Power, temperature, liquid metal flow, liquid metal level, coolant purity, and pressure measurements and damaged fuel element detection are discussed. (M.C.G.)

5001 WHY CANADA IS DEVELOPING HEAVY WATER REACTORS. J. Lorne Gray (Atomic Energy of Canada Ltd., Chalk River, Ont.). New Scientist, 11: 668-71(Sept. 14, 1961).

The development of heavy water reactors in Canada is reviewed. The validity of the nuclear physics in the Canadian heavy water, natural uranium system is discussed. Fuel development, coolant studies, development of high burn-up in the natural uranium system, and cost estimates are assessed. Neutron economy and replaceability of nuclear components in these reactors are discussed. (M.C.G.)

5002 MATERIALS FOR REACTORS: SOME BASIC QUESTIONS. G. W. Greenwood and G. K. Williamson (Central Electricity Generating Board, [London]). New Scientist, 11: 878-90(Sept. 28, 1961).

Problems involved in predicting the behavior of materials in reactors are discussed. Ways in which the interactions of neutrons can alter the properties of reactor materials are described. The effects of atomic displacement, transmutation, and fission product formation were investigated. (M.C.G.)

5003 FOULING IN ORGANIC REACTORS. C. A. Trilling (Atomics International, Canoga Park, Calif.). Nuclear Eng., 6: 523-4(Dec. 1961).

The present evaluation of the fouling problem in organic reactors has led to the development of a self-consistent theory which fits and explains all the experimental data obtained from the operation of the OMRE and of high temperature out-of-pile organic loops. The problem of controlling the insoluble matter content of the organic coolants which causes fouling is discussed. The films observed on all surfaces outside of the high flux regions of the OMRE were extremely thin (less than 0.0001 in. thick after three years) and have shown every indication of saturation in a short period of time without increasing the susceptibility of these surfaces to the formation of further deposits. However, the potential build-up of insulating fouling films at the surface of the fuel elements could cause a derating of the heat transfer capabilities of the core and possibly a complete interruption of the operation of the reactor. (N.W.R.)

5004 SELECTING A FUEL CYCLE FOR MAGNOX REACTORS. [PART] II. N. L. Franklin, A. Johnson, and E. Clough (United Kingdom Atomic Energy Authority, Risley, Eng.). Nuclear Power, 6: No. 68, 77-9(Dec. 1961).

The various fuel cycles available to magnox reactors are described. The cycles are described for the Calder Hall and Chapelcross reactors. The cycles described are: batch discharge, equilibrium, delay, and axial and radial interchange schemes. The channel replacement rate for a failure dominated cycle is also described. (N.W.R.)

5005 IMPROVEMENTS IN NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). British Patent 884,298. Dec. 13, 1961.

An operating device for control, observation, and repairs of reactor cores is designed whereby the number of orifices required in the shield is reduced. The device includes at least one distributing tube for communication between the inside and outside of the shield and which is movably carried by the shield so that it can be pivoted about a point to engage one of a number of channel outlets. The device is similar to that described in British Patent 869,539, except that the pivoting tube also is slidable about its axis. (D.L.C.)

5006 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to Commissariat à l'Énergie Atomique). British Patent 884,498. Dec. 13, 1961.

A boiling water reactor is designed for use in cases where it may be subjected to tilting and other movements, e.g., on a ship. The reactor water level is regulated so that the natural circulation pressure head is reduced and the effect of inclination on the level is reduced. (D.L.C.)

5007 AN ATTACHED FIN-TYPE TUBE AND METHOD OF MAKING THE SAME. (to Calumet & Hecla, Inc.). British Patent 884,607. Dec. 13, 1961.

An improved method is outlined for making attached-fin type tube structures for heat transfer, e.g., on reactor fuel tubes. The method results in a tube provided with at least one pair of ribs projecting radially outwards from the tube surface and separated by a radial groove, in which a fin is clinched in place. Thus, the fin is disposed outside and not in the actual radial tube thickness, and the full strength of the tube thickness is utilized. (D.L.C.)

5008 METHOD OF FORMING A FUEL ELEMENT FOR A NUCLEAR REACTOR. Edwin H. Layer, Jr. and Charles S. Peet (to U. S. Atomic Energy Commission). U. S. Patent 3,018,238. Jan. 23, 1962.

A method is given for preparing a fuel element for a nuclear reactor. The method includes the steps of sandblasting a body of uranium dioxide to roughen the surface thereof, depositing a thin layer of carbon thereon by thermal decomposition of methane, and cladding the uranium dioxide body with zirconium by gas pressure bonding. (AEC)

5009 EXPERIMENTAL LIQUID METAL FUEL REACTOR. J. J. Happell, G. R. Thomas, R. P. Denise, and J. L. Bunts, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,018,239. Jan. 23, 1962.

A liquid metal fuel nuclear fission reactor is designed in which the fissionable material is dissolved or suspended in a liquid metal moderator and coolant. The liquid suspension flows into a chamber in which a critical amount of fissionable material is obtained. The fluid leaves the chamber and the heat of fission is extracted for power or other utilization. The improvement is in the support arrangement for a segmented graphite core to permit dif-

ferential thermal expansion, effective sealing between main and blanket liquid metal flows, and avoidance of excessive stress development in the graphite segments. (AEC)

5010 SPRING DRIVEN ACTUATING MECHANISM FOR NUCLEAR REACTOR CONTROL. Frank Bevilacqua, Donald F. Uecker, and Edward F. Groh (to U. S. Atomic Energy Commission). U. S. Patent 3,018,240. Jan. 23, 1962.

A mechanism is designed for quickly inserting a control rod in a nuclear reactor to shut it down. The control rod or an extension thereof is wound on a drum as it is withdrawn from the reactor. When an emergency occurs requiring the reactor to be shut down, the drum is released so as to be free to rotate, and the tendency of the control rod or its extension coiled on the drum to straighten itself is used for quickly returning the control rod to the reactor. (AEC)

Power Reactors

5011 (ANL-6437) AN EVALUATION OF REACTOR CONCEPTS FOR USE AS SEPARATE STEAM SUPERHEATERS. D. H. Lennox, D. R. MacFarlane, R. C. Brubaker, E. L. Martinec, R. R. Rohde, B. J. Toppel, and H. Unger (Argonne National Lab., Ill.). Oct. 1961. Contract W-31-109-eng-38. 73p.

Various reactor concepts were compared for use as a separate superheater which could be added on to an advanced 300-Mwe reactor producing saturated steam. Fossil steam plant superheat temperatures were used as a criterion for selecting nuclear superheat temperatures. Therefore, the performance specified for the superheater was a minimum exit steam temperature of 566°C (1050°F) when supplied with saturated steam at either 71 atm (1050 psia) or 167 atm (2450 psia). A preliminary screening of ten different reactor concepts resulted in the selection of two for a detailed evaluation. These are a direct-cycle, water-moderated reactor, and an indirect-cycle, sodium-cooled reactor. The steam-cooled, water-moderated system is judged to have the best chance for initially reaching 566°C (1050°F), whereas, the indirect-cycle, sodium-cooled system is considered best for subsequent advances to exploit the more efficient, high-pressure steam reheat cycles. A design concept was selected for each of the reactors to establish a basis for the detailed evaluations and comparisons. The technical evaluation of the two concepts shows that the sodium-cooled, indirect-cycle superheater can realize a significant reduction in the gross plant heat rate [0.6097 to 0.5404 cal/watt-sec (8710 to 7720 Btu/kwh)] by use of the 164-atm (2400 psig) reheat steam cycle. This is not feasible with the water-moderated superheater, because of an assumed limitation of 71 atm (1050 psia) on large-size pressure vessels for reactors. This restricts the direct-cycle superheater to the use of 69-atm (1000-psig) turbines without reheat. On the other hand, to reach the specified steam exit temperature of 566°C (1050°F), the direct-cycle concept requires less extrapolation of current technology. Oxide fuel is suitable for the direct-cycle reactor but carbides are necessary to reach sufficiently high sodium temperatures with the indirect-cycle reactor. Both concepts need fuel cladding of high creep strength; however, the problems of corrosion and erosion are alleviated in a sodium-cooled system. Cost estimates give an advantage to the water-moderated, direct-cycle system although both show a net reduction in power costs when added as separate superheaters to a boiling water reactor. The significance of a size factor for plants in the 500-Mwe range is illustrated by comparisons made in this study. Power costs for the direct-cycle superheater, boiling water reactor combination were almost identical with those of an integral-type water-moderated direct-cycle system. This is because two of the integral-type units are required to match the power (575 Mwe) of the separate superheater-boiler combination. Conversely, with the sodium system, a separate sodium-cooled superheater, sodium-graphite boiler combination gives higher power costs than an integral-type sodium system because only one reactor is required for the latter in the 500-Mwe range. This study was centered on an approach to cheaper nuclear power through higher over-all thermal efficiency. To reach the ceiling now imposed by steam turbine technology, higher temperatures are indicated for the sodium-cooled superheater, since it is already amenable to the use of a high-pressure, reheat steam cycle. Alternatively, the direct-cycle, steam-cooled superheater (in the light of current development programs) is closer to the current limit to turbine temperature so that the major degree of freedom remaining is increased pressure for improved cycle efficiency. (auth)

5012 (ANL-6442) COST FUNCTION STUDIES FOR POWER REACTORS. J. Heestand and L. T. Wos (Argonne National Lab., Ill.). Nov. 1961. Contract W-31-109-Eng-38. 64p.

A function to evaluate the cost of electricity produced by a nuclear power reactor was developed. The basic equation, revenue = capital charges + profit + operating expenses, was expanded in terms of various cost parameters to enable analysis of multiregion nuclear reactors with uranium and/or plutonium for fuel. A corresponding IBM 704 computer program, which will compute either the price of electricity or the value of plutonium, is presented in detail. (auth)

5013 (CVNA-100) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., RESEARCH AND DEVELOPMENT PROGRAM QUARTERLY PROGRESS REPORT, JULY–AUGUST–SEPTEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract [AT(30-1)-2289]. 208p.

Progress is reported on the development of the Carolinas-Virginia Power Reactor. Nuclear design, pressure tube assembly development and analysis, fuel development, irradiation experiments and analyses, materials development and fabrication techniques, component development, plant system development, instrumentation and control, safety analysis and evaluation, and critical experiments are discussed. (M.C.G.)

5014 (DP-628) MODERATOR CIRCULATION IN A POWER REACTOR. Hugh E. Wingo (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1961. Contract AT(07-2)-1. 17p.

The circulation of water moderator in a full-scale hydraulic mockup of a 60° sector of a power reactor in which the moderator is circulated separately from the coolant showed only small eddies and regions of stagnation in zones of low heat generation when water was pumped into the moderator space through a side inlet near the bottom of the cylindrical wall of the mockup. High energy water jets, fed from special tubes placed in critical locations in the core, reduced the eddies and regions of stagnation and caused the moderator to flow almost uniformly upward. The water flowed from the mockup through an outlet pipe near the top of the cylindrical wall. (auth)

5015 (DP-675) HEAVY WATER MODERATED POWER REACTORS. Progress Report, October 1961. R. R. Hood and L. Isakoff, comps. (Du Pont de Nemours

(E. I.) and Co. Atomic Energy Div., Wilmington, Del.). Nov. 1961. Contract AT(07-2)-1. 36p.

At the end of October 1961, construction of the Heavy Water Components Test Reactor (HWCTR) was nearly complete, and prestartup operations were begun. A tentative schedule was prepared for irradiation of various test fuel elements in the HWCTR. Six Zircaloy-clad tubes of compacted uranium oxide were irradiated uneventfully to modest exposure in a Savannah River reactor, and are awaiting destructive examination. Buckling measurements were made on six lattices of natural UO_2 rod clusters in D_2O. In a heat transfer test at Columbia University, burnout was reached in an electrically heated bundle of nineteen rods at a maximum heat flux of 330,000 pcu/(hr)(ft^2) when the exit steam quality of the boiling water coolant was 56%. (auth)

5016 (EURAEC-1) UNITED STATES—EURATOM JOINT RESEARCH AND DEVELOPMENT PROGRAM POWER REACTOR DEVELOPMENT. SUMMARY DIGEST AND PROGRESS REVIEW, PERIOD ENDING DECEMBER 31, 1960. VOLUME 1, NUMBER 1. (United States—Euratom Joint Research and Development Program). 48p.

The summary is intended to provide highlights of the progress of the Joint Program sponsored research and development work, based on technical reports submitted by the various contractors. Research programs are summarized in the following areas: development of reactor fuels, plutonium recycling, reprocessing of irradiated fuels, disposal of radioactive wastes, development and evaluation of reactor materials, heat transfer, hydrodynamics, instrumentation, statistical calculations of hot channel factors, and nuclear applications of transient electro-analytical methods. (B.O.G.)

5017 (GA-1612(Vol.I)) MARITIME GAS-COOLED REACTOR PROGRAM. MGCR PROTOTYPE PRELIMINARY DESIGN. VOLUME I. (General Atomic Div., General Dynamics Corp., San Diego, Calif. and General Dynamics Corp. Electric Boat Div., Groton, Conn.). Dec. 9, 1960. Contract AT(04-3)-187. 197p.

The status of design of the MGCR prototype plant as of July 1, 1960 is presented. A physical description of the plant and pertinent analyses of performance are given. Materials technology and fabrication procedures are discussed. (M.C.G.)

5018 (GAMD-1572) THERMAL DESIGN OF THE PRESSURE VESSEL AND THERMAL SHIELDS OF MGCR. J. T. Rogers and G. J. Malek (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Aug. 8, 1960. Contract AT(04-3)-187. 49p. (MGCR-RE-269)

A thermal design analysis was made for the MGCR pressure vessel and thermal shields. Two pressure vessel configurations were analyzed: (1) an internally insulated, externally cooled vessel, and (2) an externally insulated vessel, internally cooled with reactor inlet gas. The limitations of both configurations were defined. The results showed that the internally insulated vessel was inherently safer and more reliable and was therefore tentatively chosen as the preliminary reference design for the MGCR. An economic comparison of the configurations is still to be made. A preliminary analysis was made of several external coolants for the pressure vessel. These were air, helium, water, and several organic heat transfer fluids. The organic heat transfer fluids were found to be superior to the other coolants considered and it was recommended that a more exhaustive analysis be made to select the best coolant and design arrangement. (auth)

5019 (GAMD-2154) HTGR PRESSURE AND DIFFERENTIAL PRESSURE INSTRUMENTS. J. T. Bauer (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 31, 1961. Contract AT(04-3)-314. 16p.

The possibility of separating pressure and differential pressure indicating instruments from the helium systems of the HTGR by means of a diaphragm-sealed filled system is discussed. It is recommended that conventional instrumentation be used in the reactor, main coolant system, helium handling and storage system, and control rod drive system and that diaphragm-sealed filled systems utilizing a NaK fill be used in the purification system where high gas activity occurs. (D.L.C.)

5020 (GNEC-168) CONTAINMENT MEMBRANE DEVELOPMENT FOR THE BONUS REACTOR BUILDING. Terminal Report Under BONUS Activity 66-8. (General Nuclear Engineering Corp., Dunedin, Fla.). May 15, 1961. Contract AT(40-1)-2674. 74p.

The containment building for the BONUS power station, because of its large volume, will be subjected to pressures of 5 psig in case of the maximum credible accident. Therefore, the steel dome need only be anchored to and sealed to a concrete base slab. For the design of the concrete slab, air permeability tests were made on concrete samples of thickness 4 to 42 in.; the observed premeabilities range from 0.05 to 10 in^3/hr-ft^2 at 6 psi differential pressure, according to whether the test was made in the laboratory or in the field. A membrane system was developed which should reduce the premeability of the concrete slab at ~6 psi differential pressure to less than 1% of the tolerable BONUS containment leak rate. (D.L.C.)

5021 (GNEC-176(Del.)) GAS COOLED REACTOR PROJECT. Terminal Report. (General Nuclear Engineering Corp., Dunedin, Fla.). June 10, 1961. For East Central Nuclear Group and Florida West Coast Nuclear Group, Inc., St. Petersburg, Fla. 102p.

Progress is reported for the design and development program of the ECNG-FWCNG prototype gas-cooled, heavy water-moderated, pressure-tube type reactor. A major accomplishment was the production of helically finned beryllium tubing. Several leaktight rolled joints of Zircaloy-2 to 42% Ni–Fe were also made. (D.L.C.)

5022 (GNEC-202) NUCLEAR SUPERHEAT DEVELOPMENT PROGRAM. Ninth Quarterly Progress Report, July–September 1961. (Combustion Engineering, Inc., Windsor, Conn. and General Nuclear Engineering Corp., Dunedin, Fla.). Contract AT(11-1)-795. 127p.

Revisions of the preliminary design of the NUSU nuclear superheat reactor are reviewed, including changes in the fuel assemblies and elements, steam-flow paths, and steam-separation systems. Mechanical, nuclear, thermal, and hydraulic analyses of the preliminary design are summarized. The results of critical experiments using double-annular elements and annular multitube elements are described. The development of vibratory-compacted multitube fuel elements, as well as the development of steam separators, is examined. A program for in-pile irradiation testing of NUSU fuel elements is discussed. The development of superheat cladding materials is reviewed. (T.F.H.)

5023 (HPR-11) PRESSURE TESTS FOR HBWR ROCK CONTAINMENT. OEEC Halden Reactor Project Report. Aldo Sutter (Norway. Institutt for Atomenergi. OEEC Halden Reaktor Prosjekt). Sept. 1961. 38p.

The leaktightness of the HBWR rock containment was tested during two consecutive experiments. The over-all leak rate was determined by pressurizing the sealed con-

tainment with air and measuring the rate of air input necessary to compensate leakage and maintain a constant air overpressure over an extended testing period and by measuring the decay of pressure after initial pressurization of the containment. Both methods were in good agreement and showed a leak rate for the HBWR containment of the order of 1.8 $nm^3/h/10$ m bar for a range of air overpressure between 0.1 and 0.3 bar. (M.C.G.)

5024 (MND-MD-2539) PM DEVELOPMENT; TASK 5.0 LOCAL BOILING HEAT TRANSFER TESTS. Single Tube Heat Transfer and Pressure Drop Tests. J. J. Jicha, Jr. and S. Frank (Martin Co. Nuclear Div., Baltimore). July 1961. Contract [AT(30-1)-2706]. 152p.

Local boiling heat transfer and pressure drop data were obtained on the inside of a single tube test section which was dimensionally identical to a PM-1 fuel element. A total of 242 experimental runs were performed, including 132 local boiling runs. The test parameters covered were: system pressure from 800 to 1500 psia; flow rates of 1.2 to 9.0 gpm; inlet coolant temperature of 445°F; and heat flux of 0.1×10^6 to 1.3×10^6 Btu/hr-ft^2. The local boiling pressure drop data were successfully correlated, using an equation of the form: $f/f_{iso} = a + bj + c$ (Re), where f/f_{iso} is the ratio of the local boiling and isothermal friction factors, j, the heat transfer factor, is the product of the Stanton number times the Prandtl number of the two-thirds power ($St \times Pr^{2/3}$), Re is the Reynolds number, and a, b, and c are pressure-dependent constants. The equation has been successfully applied to data from a previous study. The pressure dependency of the constants, a, b, and c, was established by at least squares fit of the data at each pressure. The linearity of the equation was verified in part by the high values of the multiple correlation coefficients from 0.82 to 0.93; calculated standard deviations ranged from 0.152 to 0.201. Ranges of the correlation parameters were: j factor, 1.5 to 12.0×10^{-3}; and Reynolds number, 0.7 to 5.5×10^5. Wall superheat data for local boiling heat transfer were consistently greater than those predicted by the generally employed Jens and Lottes equation, although they were generally within the uncertainty associated with that equation. (auth)

5025 (MND-MD-2541) PM DEVELOPMENT—TASK 1.1. PLANT DESIGN STUDIES. R. L. Baer (Martin Co. Nuclear Div., Baltimore). Dec. 1961. Contract AT(30-1)-2706. 96p.

Studies showed that it is feasible to simultaneously increase the thermal and electrical output of the PM-1 plant. A preliminary design of this uprated plant showed that the thermal power can be increased to 17.8 Mw(t) and the electrical output to 2290 kw(e) net without any primary system equipment changes, other than the use of a second generation PM-type core. The thermal power output of this uprated plant is completely independent of the site electrical requirements; consequently, the plant is well suited for testing advanced, long-lived, PM-type cores. A parametric study of the primary system of PM-type power plants, covering a power range of 6.0 to 20.0 Mw(t), was conducted. The results show that the costs of the major primary system components vary little with power rating; hence, large reductions in the capital cost per unit of power output can be achieved by the construction of higher powered plants. The combination of design pressure and flow rate yielding the minimum capital cost was determined for the range of powers studied. It was found that the optimum design pressure increased as the plant power increased. The PM-1 design objectives and criteria were reviewed to determine what, if any, benefits were obtainable by their revision. It was found that appreciable cost savings would result if power quality requirements were relaxed, plant output voltage were lowered and some duplicate instrumentation were not required. Further, it was found that by relaxing code requirements pertaining to piping systems, appreciable savings in size and weight could be achieved. The design of a PM plant with an electrical output of 3 to 5 Mw(e) was initiated. Based on the thermal limitations of an advanced PM-type core and the heat transfer performance of vertical steam generators, it was found that a PM-type, air transportable primary system was capable of power production as high as 29.5 Mw(t). A description and FORTRAN listing of an IBM 7090 code which will both size and evaluate pressurizers is given. The running time of the code is approximately 10 seconds per case. (auth)

5026 (MND-MD-2560-2) PM RESEARCH AND DEVELOPMENT PROGRAM. 2nd Quarterly Progress Report, July 1, 1961 to September 30, 1961. R. L. Baer (Martin Co. Nuclear Div., Baltimore). Contract AT(30-1)-2706. 121p.

Core design development. The design of advanced cores, suitable for use in the PM-1 plant, was continued. Nuclear analysis and mechanical design studies were performed. It was determined that a core life of 60 megawatt-years is attainable without increasing the PM-1 core external dimensions. Plant design development. Studies to determine the feasibility of uprating the PM-1 plant were completed and show that by changing operating conditions and incorporating suitable equipment additions the plant is capable of producing 17.8 Mw(t) while delivering 2290 kw(e) to the site. The primary system parametric study was completed. Fuel element and core component development. Analytical fuel element cermet design techniques were used to establish a UO_2 particle size range of interest. Experimental evaluations of UO_2 and stainless steel matrix materials were initiated and the preparation and evaluation of spherical UO_2 powders were continued. The design of the finger-type control rod tests assemblies was completed. Critical experiments and zero power testing. All experimental aspects of the lumped poison rod studies were completed. Zoned poison experiments were initiated and the analysis of experimental results was continued. Heat transfer tests. The two-phase outlet restriction pressure drop program was initiated. Further analysis of the burnout data obtained using STTS-4 was performed. The fabrication of an improved burnout test section, STTS-5, has been initiated. (auth)

5027 (NAA-SR-Memo-4094) ANALOG STUDY OF THE HNPF PROTECTIVE SYSTEM FOR THE U–Mo CORE. D. E. Fletchall (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.). July 16, 1959. Contract [AT(11-1)-Gen-8]. 42p.

The analog diagrams used in the simulation of the protective system are described. With the reactor operating at full power and flow, control rod withdrawal, loss of coolant flow, and coolant inlet temperature transients were studied. Scrams and setbacks on signals from the power-flow comparator and high outlet coolant temperature circuits were investigated for each transient. Setback hysteresis, thermocouple time constants, and scram and setback setpoints were the parameters studied. Startup transients with setback from the period circuit in the intermediate power range were investigated. Time for setback to occur was the variable parameter for the startup transient. Recommendations are included for further studies to insure protection for the core against high temperature when operating at reduced power and flow. (B.O.G.)

5028 (NAA-SR-Memo-4823) RADIOLOGICAL HAZARDS FROM RUPTURE OF THE SECONDARY COOLANT SYSTEM OF THE 10 Mw ESCR. A. R. Piccot (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 19, 1960. Contract [AT(11-1)-Gen-8]. 22p.

The hazards study was made to determine the radiation level from the secondary sodium lines of the 10-Mw ESCR, and to evaluate the corresponding radioactive concentration in the secondary loop and the maximum permissible effective activation flux in the intermediate heat exchanger. The results are presented graphically: the radiation level from the coolant lines during normal operation as a function of line diameter and Na^{24} concentration; the effective thermal neutron activation flux level in the intermediate heat exchanger as a function of the Na^{24} concentration in the secondary loop and the ratio of the time spent in the flux field to the time spent in making one cycle; average Na^{24} concentration in the reactor room atmosphere for operative and inoperative ventilation systems, assuming that all the sodium in the secondary system is released to the room and burns; and the downwind concentration of Na^{24} resulting from the release of all the secondary sodium on an open pad area exterior to the reactor building. An analysis of the results shows that in the event of an accident the toxicological hazards are more severe than the radiological hazards. Recommendations are given for minimizing the toxological hazards. (B.O.G.)

5029 (NAA-SR-Memo-4996) STRESS ANALYSIS OF THE HNPF REACTOR VESSEL INLET NOZZLE REGION. H. L. Sujata (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 2, 1961. Contract [AT(11-1)-Gen-8]. 25p.

An evaluation was made of the stresses existing in the HNPF reactor vessel inlet nozzle region for two cases: (1) where the nozzle is protected by the liners and (2) where a liner is not present. The most highly stressed region for case (1) exists at the point where the liner connects to the reactor vessel nozzle. These stresses were conservatively computed to be equal to 128,000 psi based on an elastic analysis. A fatigue analysis of this portion of the nozzle indicates that the resulting damage factor is less than 0.1. This compares with an allowable damage factor of 0.8. For case (2) it is found that the maximum stress exists at the center of the curved portion of the nozzle. The stress level in this particular case was found to be approximately 126,800 psi based on an elastic analysis. The resulting damage factor for this case is also less than 0.1. (auth)

5030 (NAA-SR-Memo-6626) REACTOR MAIN COOLANT LOOP. G. R. Terpe and B. Katz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 4, 1961. Contract [AT(11-1)-Gen-8]. 11p.

A parametric study was made for the POPR with temperature gradients of 610 to 670°F and 610 to 684.5°F at organic flow rates of 17.8×10^6 and 14.4×10^6 lbs/hr, respectively; and steam turbine conditions at the throttle of 600 and 650°F at 800 to 1200 psig. The study was made to obtain the most economical layout of the main heat transfer loop system. (B.O.G.)

5031 (NAA-SR-Memo-6631) HNPF WASH CELL DEVELOPMENT. W. A. Kaspic (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 22, 1961. Contract [AT(11-1)-Gen-8]. 27p.

A Hallam fuel element wash cycle has been established. This cycle, determined after forty washings of the Hallam prototype (19-rod U-10% Mo) fuel element assembly, consists of introducing saturated steam (212°F) into the preheated (200°F) wash cell at a rate of 100 lb/hr for a period of fifteen minutes. At the conclusion of the steaming operation, the wash cell is first flushed with nitrogen to remove the bulk of the water vapor and then vacuum dried. (auth)

5032 (NSEC-47) IN-PILE LOOP TEST FOR THE PEBBLE BED REACTOR FUEL ELEMENT DEVELOPMENT PROGRAM. Final Report. R. C. Koch, G. L. Grandy, I. J. Gruverman, R. F. Weise, and C. R. Wilson (Nuclear Science and Engineering Corp., Pittsburgh). Apr. 28, 1961. Changed from OFFICIAL USE ONLY Oct. 24, 1961. For Sanderson and Porter, New York. Contract AT(30-1)-2378, Subcontract S-3. 142p.

An in-pile loop using low-pressure helium was designed and operated in the Brookhaven Graphite Reactor to carry out tests of two Pebble Bed Reactor fuel spheres containing UO_2 shot admixed with graphite. The fuel particles in one sphere were coated with Al_2O_3, while those in the other sphere were left uncoated. Data were obtained for the release rates of fission products from both spheres; the results are consistent with these expected for fission recoils. (D.L.C.)

5033 (PRDC-TR-50) MONTHLY TECHNICAL REPORT [ON POWER REACTOR DEVELOPMENT], AUGUST 1961. (Power Reactor Development Co., Detroit). Contract AT(11-1)-476. 14p.

APDA activities for August 1961 are summarized. Core design, graphite problems, materials, nuclear engineering, mechanical handling, electrical and instrumentation, liquid metal and steam systems, and test operations are discussed. Results of the airborne dust sampling and analysis program are included. (M.C.G.)

5034 (WCAP-4059) CAROLINAS VIRGINIA NUCLEAR POWER ASSOCIATES, INC., CVTR PROJECT MONTHLY PROGRESS REPORT, SEPTEMBER 1961. (Westinghouse Electric Corp. Atomic Power Dept., Pittsburgh). Contract AT(30-1)-2289. 19p.

The endurance run on the U-tube was completed in September. The unit cell moderator tank was removed from the test facility and a hydrostatic test was performed on the U-tube. The U-tube was subjected to 2500 psi pressure and held for one and one-half hours. The Conoseal joints at the U-bend, transition joint and refueling port plugs were checked for leakage during this period. No detectable leakage was evidenced at any of the seals. A second Zircaloy–stainless steel joint with an Inconel sleeve was placed on test. Tests with the first joint were successful. A series of additional vacuum drying tests were performed using the Phase II pressure tube with fuel assemblies in both legs. Heat lamps were directed at both legs and the total number of lamps was doubled over the number used for the tests on the Phase I pressure tube. The results indicated a drying time considerably reduced over the time determined by previous tests. The control rod drive system test facility was modified for operation of two control rods simultaneously. Vertical drive shafts simulating the plant drive connection from the mechanism to the miter box were also incorporated. The drive mechanism was modified for operation at two speeds and to receive a larger servomotor. Hot lab work to be performed on fuel rods from CVTR capsules A-2 and A-4 was reviewed in detail with WTR. The ALPS code was modified and debugged in order to investigate accidents in which the pressurizer is allowed to empty. A run was made for the 36-tube, 16 kw per foot core using a single, large size in-

jection pump. In this case, the pressurizer empties in 9.5 seconds and results in an abrupt reduction in system pressure. Two-phase flow with a large percentage of steam voids occurs at the inlet to the main circulating pumps. The possibility of eliminating this condition by injecting part of the emergency coolant at the inlet side of the main pumps is being investigated. The reduction in system pressure also results in the injection pump operating beyond its flow design point. This problem is being investigated by Stone & Webster. The experimental measurements at the critical facility continued in the 64 cluster half-height core with a 6.5 inch by 6.5 inch micro-pitch with 1.1% fuel. The core arrangement was then modified by changing the micro-pitch of 16 of the fuel clusters. Measurements were made at two different micro-pitches with this arrangement. Upon completion of this work, the critical experiments were terminated. (auth)

5035 METHODOLOGY OF COST CALCULATION IN NUCLEAR POWER STATIONS. [PART] I. Walter Bauer (Studiengruppe für Angewandte Radio- und Strahlenchemie, Heidelberg, Ger.). Atomwirtschaft, 6: 530-6(Nov. 1961). (In German)

A general cost equation for all reactor types is worked out which makes possible an exact calculation of energy costs and, further, provides a basis for operational arrangements in nuclear power stations. It takes into consideration equally economic, technical, and nuclear-physical points of view since only a total study of a projected reactor construction and of possible technical and costwise improvements during operation gives a picture of the profitableness of the installation. (auth)

5036 A GENERAL SURVEY OF THE INFLUENCE OF HEAT TRANSFER ON THE PERFORMANCE OF GAS-COOLED POWER REACTORS. H. H. Gott, J. Brown, and J. P. Bond (Central Electricity Generating Board, Bankside, London). J. Brit. Nuclear Energy Conf., 6: 278-88 (Oct. 1961).

Fundamental design limitations are considered. These include maximum allowable temperature of the fuel can, the uranium fuel, and the coolant and the the deterioration of nuclear characteristics with increasing use of canning materials. Extended surfaces are discussed in terms of their theoretical justification, heat transfer mechanisms, fuel element design and development, and variation effects. (L.N.N.)

5037 PIQUA NUCLEAR POWER FACILITY. 1. STATUS REPORT. E. F. Weisner. 2. GENERAL DESCRIPTION OF THE PIQUA REACTOR. Nuclear Eng., 6: 515-22 (Dec. 1961).

The broad engineering design of the Piqua Nuclear Power Facility is described, and the characteristics of the plant are outlined. A simplified composite diagram of the flow system is presented. A schematic diagram of the complete facility is also presented. Tables are presented on the physical properties of the ortho-, meta-, and para-terphenyl coolant, potential hazards, and characteristics of the plant. (N.W.R.)

5038 OPERATING EXPERIENCE WITH NUCLEAR POWER STATIONS. "Review Series–Monograph Collection No. 16" of the International Atomic Energy Agency, Vienna. A. K. Krasin and B. A. Semenov (International Atomic Energy Agency, Vienna). 1961. 75p. (STI/PUB/15/16). $1.00(IAEA).

A survey is presented of the experience gained from operating a number of experimental and industrial atomic power stations using various types of power reactors. Operating experience with Russia's First Atomic Power Station, superheated steam, and BR-5 fast neutron reactors; the United Kingdom's Calder Hall type reactors; and the USA's EBWR, PWR, and SRE is discussed. The question of steam superheating is reviewed. It is pointed out that, although the construction and operation of the majority of atomic power stations are still at an experimental stage, the types of reactors considered already find applications in the field of nuclear power engineering. The present status and future development of industrial uses of nuclear power are outlined. (auth)

5039 SMALL AND MEDIUM POWER REACTORS. VOLUME II. PROCEEDINGS OF THE CONFERENCE ON SMALL AND MEDIUM POWER REACTORS, SPONSORED BY THE INTERNATIONAL ATOMIC ENERGY AGENCY AND HELD AT VIENNA, 5-9 SEPTEMBER 1960. (International Atomic Energy Agency, Vienna). Sept. 1961. 461p. STI/PUB/30(Vol.II). $7.00(IAEA).

Fifty-four papers were orally presented and are published in two volumes. Of the 29 included in volume II, 28 are covered by separate abstracts; one was previously abstracted in NSA. The conference was sponsored by the International Atomic Energy Agency. (L.N.N.)

5040 CRITERIA AND PROCEDURES IN SAFETY EVALUATION OF SMALL POWER REACTORS. M. B. Biles and C. K. Beck (U. S. Atomic Energy Commission, Washington, D. C.). p.3-8 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

"State of the art" practices from which guides and eventual standards for achieving reactor safety can emerge are discussed. To some extent, regulatory approval of reactor projects also involves certain administrative judgments which can become the basis for additional criteria. These two aspects together constitute the framework for evaluation and approval of reactor projects from the safety standpoint. Changes in procedures, considerations of policy decisions relative to reactor approvals, and trends in the matter of establishing criteria or guides in reactor safety in the United States of America will be discussed. (auth)

5041 SOME SAFETY ASPECTS OF UNDERGROUND INSTALLATION OF NUCLEAR REACTORS. E. Jantsch (A. G. Brown, Boveri et Cie, Baden, Switzerland). p.9-19 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Underground installation of small and medium nuclear reactors shows marked advantages, at least for densely populated areas, and is gaining recognition in several European countries. After a general discussion of the most important safety aspects of underground containment the idea of "multiple containment" is discussed. The example of a Swiss project for a medium-sized nuclear power plant in triple underground containment demonstrates how difficulties with liability problems can be overcome only by technical design, without relying on any financial backing by government guarantees or other means, except normal insurance. A short evaluation of the "worst conceivable accident," implying malfunction of any two of three containments, is presented to show the relatively minor consequences of such an accident. (auth)

5042 THE NATURAL-URANIUM CYCLE FROM THE MINE TO THE PRODUCTION OF PLUTONIUM. H. Platier (Commissariat à l'Énergie Atomique, Paris). p.21-33 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In French)

Successive industrial processes in the natural-uranium

nuclear-fuel cycle are described: ore extraction, ore concentration, uranium refining, sintered-oxide fabrication, cladding, and irradiated-fuel processing. Economic data are given for each process: approximate amount of specific investment, fabrication costs, trend of development of these data, and their variation depending on the total amount of fuel fabricated. (auth)

5043 STATUS OF PLUTONIUM RECYCLE STUDIES AT THE HANFORD LABORATORIES. H. M. Parker and L. H. McEwen (General Electric Co., Richland, Wash.). p.35-55 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Progress in the Hanford Laboratories program to study recycling of plutonium in thermal reactors is reviewed. Details are included on the analytical methods and computer codes developed to characterize plutonium-enriched fuel cycles in a variety of reactors. Results are reported on studies of plutonium as a supplement to, as well as to supplant, the use of enriched uranium. Also treated is the recycling of plutonium in aggregations of reactors as contrasted to recycle in an isolated reactor. Also mentioned is the effect of reactor size on the reactivity lifetime attainable with plutonium-enriched fuels, and the effect of enrichment level on plutonium fueling economics. Physics experiments on the critical mass of H_2O-moderated, plutonium-bearing rod arrays, and on D_2O-moderated lattice measurements in the Physical Constants Test Reactor are treated. A description is given of the Plutonium Recycle Critical Facility and its use in measurements on irradiated, plutonium-bearing fuel assemblies. Mentioned as well are measurements of cross-sections of plutonium isotopes. Information is included on development of methods and solution of problems encountered in the fabrication of 19-rod-cluster, plutonium-aluminum-alloy, Zircaloy-4-clad, spike-enrichment fuel assemblies for initial loading of the Plutonium Recycle Test Reactor; plus reporting of initial operating experience in the Plutonium Fabrication Pilot Plant. Recent progress in development of fabrication techniques for ceramic fuel cores (cold and hot swaging; vibratory compaction) especially attractive for semi-remote fabrication of fuel containing high-exposure plutonium is reviewed. Experimental results and test irradiation data are also given on fundamental studies of PuO_2-UO_2 and UO_2 fuel behavior at high temperature. Fuels re-processing research on methods attractive for use with plutonium-enriched fuel-cycles are highlighted; emphasis is given to fused-salt techniques focused on close-coupled recycle concepts. A description is provided of the plutonium-enriched 85-tube 70-Mw D_2O-moderated Plutonium Recycle Test Reactor; of initial loading, critical, and pre-start-up tests under way; and of fueling plans during subsequent operation. (auth)

5044 SOME MAJOR FUEL-CYCLE PROBLEMS. J. W. Ullmann (Oak Ridge National Lab., Tenn.). p.57-69 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Principal steps in converting slightly enriched UF_6 to UO_2 fuel elements, shipping of the spent elements and the subsequent recovery of uranium and plutonium from them are described. Plutonium recycle is briefly discussed. Major problem areas which lead to high capital investment or large staffs are reviewed. Estimates are given for the investment and staffing requirements for a 100-ton per year UO_2 cycle. It is concluded that the largest capital investment in the cycle is the spent-fuel aqueous-processing plant. The increased unit costs in this plant with decreased capacity are a deterrent to setting up the entire cycle in a country until a substantial nuclear economy exists. (auth)

5045 STAFFING REQUIREMENTS AND OPERATING COSTS OF NUCLEAR POWER STATIONS. R. Guard (Kennedy and Donkin, London). p.71-81 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Studies of nuclear power costs give considerable attention to the major components; i.e., the charges on capital investment and the cost of replacing fuel. A study of remaining running costs which include the operating staff, maintenance, replacement of consumable materials, license fees and so on, is offered. This cost area represents only 10% or so of the total generating cost. However, the great attraction of nuclear power is its low fuel cost and with natural uranium in particular it is quite possible that the operating cost may be as high as 50% of this fuel cost. If the full running cost is not assumed, an economic analysis to justify the installation of a nuclear reactor may be quite false. One problem in estimating the number of operating staff for a power station is that different countries work on different principles. For example, an average American power station has a much smaller staff than an average British station of the same size. Proposals are made for allowing for national differences of this kind when comparing costs, and estimates are made of the number of staff required to man small and medium power stations. Other expenses are discussed; these could amount in aggregate to a considerable part of the running costs. (auth)

5046 REQUIREMENTS AND TRAINING OF TECHNICAL MANPOWER FOR NUCLEAR PLANTS. K. J. Frost (United Kingdom Atomic Energy Authority, Risley, Lancs, Eng.). p.83-94 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

The construction, operation, and maintenance of a nuclear power station requires an extension to an individual's knowledge and skill. The normal technical training of engineers and physicists, when followed by a period of practical experience, is found to be an excellent starting point. Construction engineers' work is largely an extension of normal practices to conditions of greater accuracy, integrity, and cleanliness. Operators require much more extensive background knowledge; the UKAEA system for training operators and commissioning teams for the graphite-moderated gas-cooled civil nuclear power station is described. Almost all the senior staff of these stations are professionally qualified engineers or physicists, with the engineers having had several years as operators of conventional plants. They therefore have a technical background which requires extending to an understanding of reactor technology and operation. Initially, each person attends a course of reactor technology which is then followed by attendance at the Calder Operation School. This latter gives instruction in the basic problems of reactor operation using an electronic simulator for demonstration purposes. Following this, a period of several months is spent in the plant, gaining experience in the Control Room, Planning, Programming Technical Section, etc., the nature and duration of this experience being largely dependent upon the job the individual is to carry out. Supervisory operational staff, normally not technically qualified, receive a simplified technical course, experience on the Calder Operation School simulator and a few months of plant practice. Other than instrument engineers, the maintenance

people require relatively little training. The instruments people require extensive theoretical and practical training lasting about one year. Details of some training courses are given. (auth)

5047 EFFECT OF THE HEIGHT OF THE SOURCE OF FISSION PRODUCTS ON THE POSSIBLE CONSEQUENCES OF A MAJOR RELEASE OF FISSION PRODUCTS FROM A SMALL OR MEDIUM POWER REACTOR. C. Vélez (Comisión Nacional de Energía Nuclear, Mexico City and Instituto Nacional de la Investigación Científica, Mexico City). p.95-107 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

A major release of fission products from a nuclear reactor is assumed and the areas enclosed by isodose curves are computed, using an IBM-650 machine, for different atmospheric conditions and dose values, the height at which the release is assumed to occur and the radius limiting the territory concerned. Effects of release of fission products are systematically calculated for different heights above the ground level of the virtual source from which the diffusion is assumed to take place. The release of fission products at some height above the ground level drastically reduces the size of the isodose curves obtained when the release occurs at ground level. This effect is particularly noticeable at short distances from the reactor. The influence of the atmospheric conditions varies according to the height. The case of temperature-gradient inversion, which is usually considered as the worst atmospheric condition, proves to be the best one, within a relatively small radius, if the release of fission products occurs at a sufficient height. (auth)

5048 STUDY OF A PLUTONIUM–THORIUM THERMAL SYSTEM. M. Dayal, M. P. Parameswaran, and S. R. Paranjpe (Atomic Energy Establishment, Trombay, India). p.109-16 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Considering that India possesses large reserves of thorium and small resources of uranium, a two-stage nuclear power program is envisaged involving natural-uranium reactors for plutonium production in the first stage, followed by Pu–Th reactors in the second stage, which can be either thermal or fast. Thermal systems are discussed and two reference designs using a Pu–Th alloy with Pu content of 1.7 and 3%, respectively, are presented. It was shown that this would result in heavy fueling and inventory charges, together with low conversion ratio, and does not appear to be attractive from an economic standpoint. Therefore, possibilities of employing fast systems have to be examined in more detail. (auth)

5049 NUCLEAR POWER COST EVALUATION. G. Petretic and R. Krymm (International Atomic Energy Agency). p.125-37 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Activities of the IAEA in the field of nuclear power costs and the methods of costing with particular reference to the less-developed countries are summarized. Plant investment, operation and maintenance, and fuel costs are briefly discussed and the limitation of the data noted. Examples are given of the influence of the method of costing upon the fuel cycle cost. The importance of the "present worth" method of fuel costing is indicated. (auth)

5050 INVESTMENT COST COMPARISON OF NUCLEAR AND CONVENTIONAL POWER PLANTS. F. W. McCloska (Sargent and Lundy, Chicago). p.139-49 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

A cost comparison is made between present-technology nuclear and coal-fired conventional plants under United States conditions of labor and equipment costs, and design and construction practices. Estimated cost information is presented for the six thermal converter reactor concepts under serious consideration in the United States, together with a comparative cost analysis for three of those concepts—pressurized-water, boiling-water and organic-moderated and cooled—which appear to have the greatest promise of being competitive with conventional plants. The investment-cost information presented is that which was developed for the USAEC to determine the present economic status of the six reactor types being considered in their future planning. Present-status reactor information was furnished by the leading proponents of each type and from this information co-ordinated flow and control diagrams, heat balances and general arrangement layout drawings were prepared in detail to form the basis of the cost estimate. A set of standard site conditions and economic and design criteria was established. Based on these conditions and criteria the design development and estimating were performed by one organization so that the capital investment of the six concepts being considered would be on the same basis and the same degree of accuracy. Three plant sizes—75, 200, and 300-Mw—were investigated for each concept. Sargent and Lundy made a study for the Argonne National Laboratory of the investment costs for conventional coal-fired plants between 25 and 325 Mw with approximately the same site conditions. A good basis for cost comparison of the various common areas of nuclear and conventional power plants is provided. It is possible to point out the cost differences and the reasons for them. The comparison indicates the differences in design requirements of nuclear and conventional plants under similar conditions, the cost penalty incurred and suggestions for engineering development in contrast to reactor development. To set reasonable limiting goals for nuclear-plant-design cost reductions, information in sufficient detail is included on the estimated costs of 300-Mw plants. (auth)

5051 ECONOMIC EVALUATION OF ATOMIC ENERGY IN INTERCONNECTED SYSTEMS CONSISTING MAINLY OF CONVENTIONAL THERMAL POWER STATIONS. A. Lévai and M. Ocsai (Office for Power Station Design, Budapest). p.151-70 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

The theoretical method of calculating the first costs of electrical energy do not differ essentially between power provided by conventional stations and that by nuclear stations, but some cost factors must be evaluated differently for each case. A survey of methods of calculation used for thermal power stations is presented, taking note of the differences for nuclear power stations. Utilizable capacities; calculation of investment costs; fissionable materials and analysis of relations of given fuel cycles; and costs of maintenance, wages, insurance, etc., are discussed. An example is given. (L.N.N.)

5052 INTEGRATION OF THE HALLAM NUCLEAR POWER FACILITY INTO THE CONSUMERS PUBLIC POWER DISTRICT ELECTRIC SYSTEM. E. Jones (Consumers Public Power District, Lincoln, Neb.). p.171-83 of "Small and Medium Power Reactors. Volume II."

Vienna, International Atomic Energy Agency, 1961. (In English)

Consumers Public Power District will operate a 75,000-kw generating station using a sodium power reactor now being constructed under a joint program with the USAEC. The integrated design, construction and operation of a new conventional plant and a high-efficiency reactor installation should provide an accurate estimate of the future economics of power-reactor operation. The operating procedures and costs will have the benefit of immediate comparison with a fossil-fueled system. In addition, this method of operation provides the opportunity to participate in the development of the peacetime application of atomic energy, while continuing to carry the electric utility company's basic responsibility of providing an adequate firm supply of economic electric energy. (auth)

5053 A SUMMARY OF THE ECONOMIC STATUS AND POTENTIAL OF UNITED STATES SMALL AND MEDIUM NUCLEAR POWER REACTORS. J. F. Kaufmann and U. Staebler (U. S. Atomic Energy Commission, Washington, D. C.). p.185-91 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

To develop a long-range and well-directed research and development program for advancing reactor technology, it is first necessary to establish objectives, to evaluate the economic and technical status of reactor concepts and to identify those areas where improvements can be made and based on the successful development of these improvements to estimate the potential reduction in power-generation cost. Such studies as these represent a part of a continuing evaluation and planning program which provides the basis for developing long-range plans. Ground rules are given as used by the USAEC to establish the current and potential economic status of the various reactor concepts. Based on the ground rules, the power-generation cost of nuclear plants built on current technology will be discussed for each of the reactor concepts. Associated with the economic discussion for each concept, there will be a brief technical description of the reactor design representing current technology. The potential areas where improvement can be made with a reasonable degree of success will be described and the potential reduction of power-generation cost will be estimated for each concept. In addition to the technical summary and economic comparison of reactor concept, results of an evaluation of light-water concepts will be presented. (auth)

5054 A RANGE OF SMALL PRESSURIZED-WATER POWER STATIONS. T. B. Webb and H. S. Prosser (Babcock and Wilcox, London and Humphreys and Glasgow, Ltd., London). p.193-208 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Small pressurized-water power stations are advocated as a most suitable type of nuclear plant for commercial electricity generation in less developed countries, particularly where fossil fuel costs are high. Reference is made to the background of experience and the technical advantages of this type of plant. Experience includes nearly 40 submarines and surface vessels either built or under construction for the United States Navy, the USSR ice-breaker Lenin, the United States merchant ship Savannah and a number of land-based power stations of both large and small output. Technical advantages discussed include the straightforward and rugged nature of the plant, its predominant use of traditional materials, together with outstanding flexibility and safety in operation. A full description is given of a power station of 20-Mw capacity as being typical of a range of units of from 10 to 100 Mw and the minor variations in design with size are indicated. Capital costs of pressurized-water power stations within this range are estimated, together with the corresponding fuel and operating costs, thereby arriving at the over-all production cost of electricity. These costs are compared with the cost of electricity from fossil-fuel-fired stations with varying load factors and fuel costs. Probable lines of development of pressurized-water reactors are discussed, and the effect of these developments upon capital and operating costs is estimated. (auth)

5055 FUEL CYCLE ECONOMICS. J. A. Lane (Oak Ridge National Lab., Tenn.). p.215-31 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

The capital cost advantage of fossil-fuelled plants compared to nuclear plants, in the range of 10 to 100 Mw, appears to follow approximately the relation $\$/kw = 1000/P^{1/3}$ or $mills/kwh = 20/P^{1/3}$, where P = Mw net capacity. Thus, to be competitive, nuclear plants must either reduce this capital cost margin of $100 to $300/kw or achieve fuel-cost savings of from 2 to 6 mills/kwh. Possible reductions in fuel cycle costs are discussed from the standpoint of variables such as neutron economy, specific power, thermal efficiency, fuel enrichment, fuel fabrication, fuel processing, and shipping. Studies of the economic advantages and disadvantages of alternate fuel mixtures (U^{235} and U^{238}, plutonium and U^{238}, U^{235} and thorium, and U^{233} and thorium) are reviewed, and the applicability of such fuel mixtures for small and medium nuclear plants is discussed. Finally, the reactor types which show the greatest promise of achieving competitive power costs in plants of the stated range are indicated. (auth)

5056 THE RELATION BETWEEN REACTOR SIZE AND FUEL COSTS. E. Masters (Preece Cardew and Rider, London). p.233-49 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Effects of reactor size on the fuel cost component of total generating costs for the cases of light-water, heavy-water and graphite-moderated reactors, are examined. The data used in the evaluation are, where possible, the published fuel costs, lattice parameters and power densities of typical power reactors now being or about to be built. The fuel cost calculations take account of the increase in fuel enrichment necessary to reach a specified fuel burn-up under the conditions of increased leakage which exist in the case of small reactors. Account is also taken of the effect of reactor size on the composition of spent fuel. The results indicate the range of output over which the different types of reactor are likely to have relatively fixed fuel costs. They also indicate the relative importance of the fuelling program in the smaller plant sizes. (auth)

5057 INVESTIGATIONS OF THE ECONOMIC POTENTIAL OF A 100,000-KWe NATURAL-CIRCULATION DIRECT-CYCLE BOILING-WATER REACTOR SYSTEM. C. F. Bullinger and J. M. Harrer (Argonne National Lab., Ill.). p.252-72 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

A design study was carried out to show how a 100-Mw natural-circulation direct-cycle boiling-water reactor power plant could be built, using current technology. The successful operation of the EBWR at Argonne National Laboratory during the past three years has demonstrated

the advantages of this concept. Many factors are developing which indicate that, when properly designed for maximum performance, the direct cycle with natural circulation and internal steam-separation will lead to the most economical boiling-water reactor design. The values used for heat transfer, flow rates, steam disengagement velocities, power densities, etc., were taken from EBWR 60-Mw(t) operating data. No basic research is required for this plant. In the course of developing the reference design many reactor arrangements were investigated. Various combinations of control-rod drive locations and fuel-handling methods were studied. The merits of both forced and natural circulation systems with internal and external steam separation were considered. The reactor vessel required for this system is the largest which can be shop-fabricated with existing equipment. Cost estimates were prepared for a stainless-steel system and for an all-carbon-steel system. Water chemistry control problems were evaluated by comparing the merits of full-flow demineralization vs. full-flow filtration plus side-stream clean-up. Various combinations of feasible core parameters were postulated to develop a range of fuel-cycle costs. Fuel fabrication cost and in-core residence time have the most significant effect on over-all fuel cost. A minimum in-core lifetime equivalent to 20,000 Mwd/t (metric) is necessary to achieve required fuel costs. High power density (50 kw/l of core) does not provide a significant advantage until long burn-ups are achieved. Total power costs are estimated to be within the following limits: (1) capital, mills/kwh 4.0–4.5; (2) fuel cycle, mills/kwh 2.5–3.5; (3) operation and maintenance, mills/kwh 0.7–1.0; and (4) insurance, mills/kwh 0.3–0.5. Range, total power cost, mills/kwh 7.5–9.5. The reactor complex used in the study has also been utilized in studies of a 300-Mw(e) plant wherein 3 units are connected in parallel to supply steam for a single turbine. It may also be combined with a steam-cooled reactor to provide superheated steam for turbine generators operating at modern temperatures and pressures. (auth)

5058 OPTIMIZATION AND COST CONSIDERATIONS FOR A SMALL GAS-COOLED POWER REACTOR. A. Mueller and D. Smidt (Deutsche Babcock and Wilcox Dampfkesselwerke A. G., Oberhausen, Ger.). p.273-90 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

One of the potential advantages of advanced gas-cooled reactors is the possibility of achieving very low capital costs. The leading principle in the presented design study of a 15-Mw power station is a high standard of simplicity and safety. For safety reasons reactor, steam generator and blowers are combined in a single cylindrical pressure vessel. The steam cycle is conventional. Results on power costs are considered for a number of principal materials. Because of the fixed steam cycle the number of free parameters for optimization is quite low. A comparison is especially made for graphite, Be and BeO as moderators, stainless steel UO_2-cermet and stainless-steel-clad UO_2-rods as fuel, and He and CO_2 as cooling gases. (auth)

5059 STUDY OF MEDIUM-TEMPERATURE REACTOR TYPES WHICH CAN BE USED IN THE CONSTRUCTION OF MEDIUM-CAPACITY POWER STATIONS. E. Parker (Centre d'Etudes Nucléaires, Saclay, France). p.291-300 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In French)

The Commissariat à l'Energie Atomique (CEA) program includes development of a graphite-moderated, CO_2-cooled, high-power-density reactor system for application both in power stations and merchant ship propulsion. Great benefit was derived from the experience gained in construction of natural-uranium reactors (graphite, magnesium), from tests carried out for EL.4 on a neighboring fuel element, and from tests carried out within the framework of the Brenda project. To complete the program of research and development now under way, however, it was decided to design and build a prototype reactor for materials and fuel testing under actual operating conditions. One of the main features of this test reactor is that the moderator can be renewed, so that both graphite studies and beryllium (BeO) studies can be carried out. This latter material, which is under investigation at the CEA, could be usefully applied in medium-capacity power stations. (auth)

5060 APPLICATION POSSIBILITIES OF SMALL NUCLEAR POWER PLANTS. L. Forgo, J. Halzl, and M. Torma (Thermal Power Design Bureau, Budapest). p.301-17 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Possibilities of applying nuclear heat to industry are discussed. Considering that the duration of peak utilization is a limiting factor for the utilization of nuclear energy in the field of condensing nuclear plants, it is stated that the national nuclear energy base, which can be realized by building nuclear condensing power stations, can be further expanded by about 50% by building heat-supplying nuclear power stations or low temperature process-heat reactors. Economic factors are discussed, and an analysis of industries susceptible of being supplied by nuclear heat in the first stage is presented. Numerical effects of heat-consumer, load-factor, and required temperature (pressure) characteristics and distance from fossil-fuel bases are discussed in relation to economic factors. Possibilities of direct heat supply from a low-temperature reactor are investigated, and price differences required between low-temperature and back-pressure-power-plant reactors to enable the former to be competitive are calculated on this basis. (L.N.N.)

5061 THE POTENTIALITIES OF THE OMR AND OTHER LIQUID-MODERATED SYSTEMS FOR THE PRODUCTION OF PROCESS HEAT. B. D. Baines and J. M. Conway-Jones (Hawker Siddeley Nuclear Power Co., Ltd., Langley, Bucks, Eng.). p.319-29 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Characteristic load requirements for nuclear reactors are reviewed and industries are indicated in which these load characteristics of high continuous heat demand and high load factor are met. The competitive advantage of heat as compared with that of power reactors is shown. The steam conditions and power requirements of these industries are reviewed in comparison with the steam conditions which may be available from liquid-moderated reactor systems within the next ten years. Detailed parameters are presented of an organic-cooled and moderated reactor capable of fulfilling the main steam requirements of the chemical industry. Back-pressure power would also be supplied to fulfil many factory requirements. Economics of conventional and nuclear heat generators are compared, and indications of the development of this comparison with time are given. (auth)

5062 CHARACTERISTIC FEATURES OF THE POWER SITUATION IN LESS-DEVELOPED COUNTRIES. J. Barnea and E. S. de Breuvery. p.337-56 of "Small and

Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Background information on the main characteristic features of the situation regarding electricity supply and demand in less-developed countries is provided. The power situation in less-developed countries is far from being uniform and generalizations are difficult. In fact, each less-developed country differs from another regarding any such relevant factors as the availability of energy resources, their nature and degree of development, the transport conditions and the structure of power demand—not to mention types of economic system, priorities in government programing, etc. A certain number of factors which predominantly affect electricity development in less-developed countries as a group, are selected. General characteristics common to all less-developed countries are reviewed, discussing respectively the power supply and demand situation; the load factor problems; the implications of power supply deficit; and the difficulties of evaluating power demand. Present cost situations and trends as affecting development of conventional power in less-developed countries are considered and in this respect hydro-power plants, conventional thermal stations, and conventional fuels are discussed. (L.N.N.)

5063 THE INTRODUCTION OF NUCLEAR POWER IN LESS-DEVELOPED COUNTRIES. P. D. Tietelbaum and F. Pikler (International Atomic Energy Agency). p.357-80 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Potential economic benefits of competitive nuclear energy in the less-developed countries are reviewed, based on the latest technical and economic information from the point of view of the length of time and scope of effort which may be necessary to achieve them. It is shown that if competitive nuclear costs are achieved in the next decade, possible benefits such as those from savings in power generating cost, capital cost, and foreign exchange, could only become significant at a somewhat later stage and in consequence of a substantial nuclear power program. (auth)

5064 THE POWER REACTOR IN ECONOMIC DEVELOPMENT. Y. Kawashima and T. Suzuki (Atomic Energy Bureau, Science and Technics Agency, Tokyo). p.381-92 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

Economic growth and increase in energy problems are discussed in terms of differences in scale and pattern of energy requirements in the advanced and less-developed countries and of the process of energy requirements due to economic development. Effects of patterns of industrialization on energy requirements are described. Power reactors are important in the increasing energy requirements. Small reactors are applicable for specific demands, and medium and large, for integrated demands. Applications for small reactors in less-developed countries are discussed. Competition between nuclear and conventional power in the process of economic development is described. (L.N.N.)

5065 TWO EXAMPLES OF THE USE OF SMALL NUCLEAR STATIONS. J. Andriot and J. Gaussens (Commissariat a l'Energie Atomique, Paris). p.393-407 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In French)

Power production by a 5-Mw nuclear plant in an isolated region with high conventional fuel costs, is considered. Conditions under which a nuclear plant would be economic as compared with a conventional plant are described as regarding fuel, load factor, and rate of industrialization in the area. Power and heat production to supply a town with a current of 25 Mw and a heat of 70 Mw are discussed. It is shown that the first stage at which nuclear power becomes economical is determined by the extent to which electric power and urban heating are linked. Only after that comes the stage at which the sale of electric power alone is economical. (L.N.N.)

5066 THE ECONOMIC JUSTIFICATION FOR LOW-CAPACITY NUCLEAR POWER STATIONS IN ISOLATED REGIONS. J. van der Spek (Société Belge pour l'Industrie Nucléaire, Brussels). p.409-24 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In English)

When there is a need for small amounts of electricity in areas remote from conventional electric power sources the cost either of fuel transport overland, or of transmission of the electricity itself by high-voltage line, may be so high that it is more economical to produce nuclear power locally. All economic considerations connected with this problem are examined, and areas of the Republic of the Congo within which nuclear power can be regarded as competitive are considered. (auth)

5067 PROSPECTS FOR SMALL OR MEDIUM-SIZED NUCLEAR POWER STATIONS IN ARGENTINA. B. J. Csik (Comisión Nacionale de Energía Atómica, Buenos Aires). p.431-8 of "Small and Medium Power Reactors. Volume II." Vienna, International Atomic Energy Agency, 1961. (In Spanish)

Nuclear power stations must fulfil certain operational requirements if they are to function under favorable economic conditions and thus be able to compete with conventional power stations. Particular conditions of the Argentine Republic are considered from the point of view of their influence on the desirability of establishing small or medium nuclear power stations. The relevant economic, technical and geographical factors are analyzed, e.g: electrification of the country; industrial development; reserves and output of nuclear fuel; present state of nuclear research; features and special conditions of different parts of the country; etc. Conclusions are given on the basis of an evaluation of these factors. (auth)

Production Reactors

5068 (HW-68609) NPR PRIMARY LOOP—EMERGENCY DUMP TESTS. H. G. Johnson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 10, 1961. Contract AT(45-1)-1350. 18p.

Dump tests were made for quenching pressurized water at 600, 545, 455, and 270°F in varying volumes of subcooled water. The tests were run using the high-pressure loop to simulate the NPR primary loop and a below-grade, uncovered, concrete pit to simulate the NPR quench tank. Ring sparger, vertical pipe, horizontal pipe, draft tube, and cross-type distributors were tested. Serious quench tank vibrations were not observed in any of the runs which included quench water temperatures of 70 to 200°F. Vibrations were nil with dumps of 455 to 600°F water. Minor vibrations developed during the dumps of 270°/275°F water with the vertical, horizontal, and cross-distributors. Vibrations were also nil with the ring sparger and draft tube during the 270°/275°F dumps. The degree of agitation varied considerably with the distributor design and loop pressure. In the high-pressure dump, the cross-distributor

gave an extremely violent agitation in which water was thrown from the pit and the froth level reached three feet above the bulk water surface in the pit. The sparger gave a mild agitation even at high loop pressure. The other distributors gave a medium to violent agitation at high loop pressure. Agitation was very mild for all distributors, except the cross and draft tube, at low loop pressure. The cross gave a medium agitation, and the draft tube gave a violent, erratic agitation. In all cases, mixing was adequate as indicated by uniform water temperatures measured at nine points in the quench pit. Condensation of the flashing water entering the quench pit was complete in all tests. Steam bubbles did not break the water surface. However, vapor was formed above the pit because of the vapor pressure of the hot water and relatively cold air temperature. This vapor formation was a maximum for the cross-distributor caused by the increased water surface from the violent agitation. (auth)

5069 THE POSSIBILITIES FOR THE OPERATION OF A NATURAL URANIUM BREEDER REACTOR WITHOUT FUEL ELEMENT PREPARATION. K. Fuchs and H. Hessel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 4: 619-23(Aug. 1961). (In German)

The advantages of a breeder reactor which operates without chemical processing of the fuel elements are evident. A rough calculation is given to demonstrate the principal possibilities of such a reactor and to calculate the obtainable burnup of the natural uranium, which is limited, on the part of the neutron physics, essentially by the absorption in the fission products and construction materials. Two cases are considered: a heterogeneous reactor in which the fuel elements move continuously through the reactor and are removed finally; and a homogeneous reactor in which the breeder material and fission material form a homogeneous solution. Natural uranium was continuously fed in and a corresponding fraction of the homogeneous mixture was removed. (J.S.R.)

Research Reactors

5070 (NAA-SR-Memo-3756) REPORT ON THE POWER TRANSIENT OCCURRING IN THE AE-6 WATER BOILER REACTOR AND STEPS TAKEN TO RETURN THE REACTOR TO NORMAL OPERATION. G. L. Blackshaw (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1959. Contract [AT(11-1)-Gen-8]. 12p.

Descriptions are given of the power transient occurring in the AE-6 Water Boiler Reactor on Dec. 20, 1958; investigations to determine the causes of the transient; an explanation of the occurrence; and steps taken to restore the reactor to normal operation. No fission gases were released during the transient and no personnel were exposed to above normal levels of radiation. (B.O.G.)

5071 (NAA-SR-Memo-3757) RELEASE OF FISSION GASES FROM THE AE-6 REACTOR ON MARCH 25, 1959. G. L. Blackshaw (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Apr. 15, 1959. Contract [AT(11-1)-Gen-8]. 10p.

An analysis was made of the fission-gas-release incident during the pressure pumpdown of the AE-6 Reactor resulting in the contamination of the reactor room and members of the operating staff. Descriptions are given of the normal core pumping procedures, procedural alterations during the incident, the discovery of the contamination and its possible causes, and the remedial actions taken. Steps taken to minimize the chance of the occurrence of the contamination in the future are listed. (B.O.G.)

5072 (NDL-TR-8) NEUTRON-FLUX MAPPING FOR THE KUKLA FACILITY, APRIL 5 TO 11, 1961. J. H. McNeilly and J. W. Kinch (Army Chemical Corps Nuclear Defense Lab., Army Chemical Center, Md.). Aug. 1961. 18p.

The threshold detector system was used in making neutron flux measurements at the KUKLA facility, Lawrence Radiation Laboratory. These included neutron flux versus distance from the source and perturbation of the neutron flux caused by the electrical components exposed in the radiation field. The flux shows a slight deviation from a $1/R^2$ dependence at distances of less than 25 cm. There is little, if any, perturbation of the flux field due to the insertion of various electrical components. (auth)

5073 THE PURIFICATION SYSTEM OF THE FEED WATER OF THE POOL OF THE JEN-1 REACTOR. M. Urgell-Comas, J. A. Pérez Bustamante, T. Batuecas Rodríguez, F. de la Cruz Castillo, and R. Fernández Cellini (Junta de Energia Nuclear, Madrid). Énergie nucléaire, 3: 261-9 (July-Aug. 1961). (In French)

The purification system for the feed water of the JEN-1 Reactor at the "Juan Vigon" Nuclear Energy Center is described. This system is composed of one preliminary unit for the treatment of hard water (sterilization, decantation, filtration) and of two units for deionization by ion exchange, the first with separate bed and the second with mixed bed. The results obtained after the first feed cycles are reported. (tr-auth)

5074 PRE-CRITICAL AND CRITICAL OPERATIONS AND MEASUREMENTS ON CESNEF L-54 REACTOR. A. Hassid, A. Rimini, V. Sangiust, and S. Terrani (CESNEF, Milan). Energia nucleare (Milan), 8: 676-86 (Nov. 1961). (In Italian)

Measurements and controls are described of the reactor characteristics. The information is necessary both for critical experiments and for further normal operation. (auth)

5075 SOME PHYSICAL CHARACTERISTICS OF THE CESNEF L-54 REACTOR. A. Hassid, S. Kaftal, A. Rimini, V. Sangiust, M. Terrani, S. Terrani, and M. Tininini (CESNEF, Milan). Energia nucleare (Milan), 8: 687-97 (Nov. 1961). (In Italian)

The operations performed to define some physical characteristics of the L-54 reactor of CESNEF are described. These operations include: power calibration by neutron flux method; power calibration by thermal method; measurements of the neutron flux and of its distribution in experimental facilities; and measurements and distribution of the gamma dose in the experimental facilities of recombiner. (auth)

5076 HEALTH PHYSICS IN CRITICAL EXPERIMENT OF CESNEF L-54 REACTOR. S. Kaftal, S. Terrani, M. Tininini (CESNEF, Milan). Energia nucleare (Milan), 8: 698-700(Nov. 1961). (In Italian)

The operations of health physics during and after the critical experiment of the L-54 reactor of CESNEF are described. (auth)

5077 ORGEL—A EUROPEAN CONCEPT. J. C. Leny. Nuclear Eng., 6: 508-12(Dec. 1961).

The initial program of research and experiment attached to the Euratom Treaty requires the Commission to carry out work in the field of reactor prototypes. At the root of the Commission's deliberations was the fact that only with natural uranium reactors could the Community be made

independent of outside fuel supplies. Thus, the Orgel system, heavy water moderated, organic cooled, permits the best use to be made of European industrial potential within the framework of an international distribution effort. Hence, the development of this system and the research to be made is discussed. (N.W.R.)

SPACE APPLICATIONS AND TECHNOLOGY

5078 (GA-2670) INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS. Quarterly Progress Report for Period Ending November 30, 1961. A. F. Weinberg, R. G. Hudson, B. Siefner, and L. Yang (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Contract NAS-5-1253. 59p.

The physico-chemical properties of mixed carbides of uranium and zirconium are being measured at temperatures up to 2400°K. Vapor-loss measurements were conducted for specimens with nominal compositions of 20 mol-% UC-80 mol-% ZrC and 90 mol-% UC-10 mol-% ZrC at 2300° ± 11°K in a vacuum of 4×10^{-9} mm Hg to establish if residual oxide layers were influencing weight-loss measurements. Comparison of the data obtained with measurements performed in vacuums of 1×10^{-5} mm Hg showed that no change was effected by the difference in vacuum. After a 95-hr exposure at 2300°K, the weight loss of the specimen with a nominal composition of 90 mol-% UC-10 mol-% ZrC continued to decrease at a constant rate. Preliminary experiments to determine the influence of a cesium-vapor environment on the weight loss are described. Electrical-resistivity measurements are being conducted for mixed-carbide specimens of differing U : Zr ratios from room temperature to 2400°K. The resistivity data obtained are represented as a linear function of temperature. A technique selected for thermal-conductivity measurements is presented and the requisite apparatus is described. A technique was developed for simultaneously studying the interdiffusion between uranium carbides and four refractory metals—tungsten, niobium, tantalum, and molybdenum. The interactions between these metals and UC_2–UC mixtures were studied at 1800°C for times up to 50 hr. Using carbon contents greater than stoichiometric UC suppressed liquid-phase formation. The growth of uniform carbide layers was found to proceed according to a parabolic rate law, and layers as thick as 1000 μ were found after 50 hr. In addition to the formation of uniform carbide layers, severe carbide penetration of the grain boundaries was observed in niobium, tantalum, and molybdenum. Investigation of the interaction between UZrC (6.0 mol-% U-45.8 mol-% Zr-48.2 mol-% C) and the same four refractory metals at 1800°C after 50 hr showed that the stabilization of the carbide phase by the addition of zirconium dramatically improves the diffusion characteristics. (auth)

5079 (JPL-TR-32-190) TEST-BED CONFIGURATIONS FOR THE FLIGHT TESTING OF SNAP-8 POWERED ELECTRIC-PROPULSION SYSTEM. Robert J. Beale, James R. Womack, Philip J. Hirrel, and Warren C. Apel (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Nov. 24, 1961. Contract NASw-6. 36p.

A study was undertaken to determine from a conceptual approach a logical test-bed configuration to meet the following requirements: (1) flight test a 30-kw(e) SNAP-8 power-generation system, (2) flight test a nominal 30-kw(e) ion motor and a nominal 30-kw(e) arc-jet motor, and (3) acquire useful spacecraft integration experience which could be directly applied to a 60- to 70-kw(e) mission spacecraft. Three distinct spacecraft concepts were reviewed: (1) a 70-kw(e) interplanetary mission spacecraft (representative of an ultimate utilization for SNAP-8), (2) a 30-kw(e) earth-satellite test bed, and (3) a 30-kw(e) interplanetary test bed. The interplanetary mission spacecraft is described as a standard with which the two types of test beds can be compared. For each spacecraft concept, several configurations are illustrated and described in detail. The descriptions include a discussion of the propulsion system, spacecraft mode of operation, guidance, control, power conditioning, instrumentation, and telecommunications. Preliminary weight and instrumentation parameters are summarized. The technical advantages and disadvantages of the two test-bed concepts are surveyed relative to the interplanetary mission spacecraft, and the recommendation to pursue the more sophisticated interplanetary test bed is made. (auth)

5080 (MND-P-2581-III(Pt.I)) ISOTOPIC POWER SOURCES—A COMPENDIUM. PROPERTY AND PROCESSES REVIEW. PART I. E. H. Smith, comp. (Martin Co. Nuclear Div., Baltimore). [1961]. Contract AT(30-3) 217. 268p.

A selective bibliography was compiled on the nuclear, physical, and chemical properties and separation processes of Sr^{90}, Y^{90}, Cs^{137}, Ce^{144}, Pm^{147}, Po^{210}, Ra^{228}, Ac^{227}, Th^{228}, U^{232}, and Np^{237}. The source was Nuclear Science Abstracts, Vol. 1 through 14 (1948 to 1960). (M.C.G.)

5081 (MND-P-2581-III(Pt.II)) ISOTOPIC POWER SOURCES—A COMPENDIUM. PROPERTY AND PROCESSES REVIEW. PART II. (Martin Co. Nuclear Div., Baltimore). [1961]. 371p. Contract [AT(30-3)-217].

A selective bibliography was compiled on the nuclear, physical, and chemical properties and separation processes of Pu, Am^{241}, and Cm. The source was Nuclear Science Abstracts, Vol. 1 through 14 (1948 to 1960). (M.C.G.)

5082 (MND-P-3015-I) SNAP RADIOISOTOPE SPACE PROGRAMS; TASK 7. Quarterly Progress Report No. 7, April 1 through June 30, 1961. (Martin Co. Nuclear Div., Baltimore). Contract AT(30-3)217. 41p.

Safety analyses of the launch of SNAP-type units as to launch, ascent, and intermediate or final-stage failures are reported. A preliminary design study to define the configuration and performance of the Surveyor generator is completed. Dispersion patterns are found for radioactive materials released by the high-velocity vertical impact of Surveyor-type generators on the moon. High-velocity testing methods are discussed. Flare and telemetry capsules, designed to simulate fuel cores of nuclear auxiliary power systems in Atlas-type ballistic re-entry trajectories, are in final production stages. The design of a SNAP-3 test generator is completed. Analytical studies are reported on the diffusivity of various particle sizes and on the ablation phenomenon as it pertains to re-entry of radioisotope fuels. A preliminary flare and telemetry capsule test is discussed. Routine coding, assembly, and checkout operations are carried out on radioisotope shielding codes. Arrangements are made to obtain code input information and actual radiation levels from the Sr^{90}-fueled weather station generator, as a check problem to verify code calculation results. (T.F.H.)

5083 (MND-SR-2615) DATA TELEMETRY PACKAGE POWERED BY STRONTIUM-90 FUELED GENERATOR. Final Report. (Martin Co. Nuclear Div., Baltimore). Sept. 1961. Contract AT(30-1)-2519. 206p.

An automatic, nuclear powered, meteorological data transmitting radio station was designed and fabricated for unattended service at a remote Arctic location. The system

automatically measures air temperature, barometric pressure, wind direction, and two wind speed averages. Once every three hours it transmits this data in binary digital form, on two frequencies, to a manned receiving station (also designed as a part of this contract) where it is recorded on a two-channel recorder. Temperature, wind direction and barometric pressure are read at the instant of transmission; wind speed is averaged during an eight-minute interval and a one-minute interval immediately preceding transmission. A five-watt thermoelectric generator was designed, manufactured and electrically tested for a period of 8.5 months. In May 1961, the generator was fueled with a capsule containing 17,500 curies of Sr^{90}. Electrical performance tests were conducted with the integrated system of generator, converter and batteries prior to isotope loading and also after Sr^{90} fueling operations. Weather station compatibility tests were performed in June 1961 and the complete power supply and station housing were packaged for overseas shipment in July 1961. Current residence of the Sr^{90} generator is on Axel Heiberg Island in the Arctic region. (auth)

5084 (NAA-SR-Memo-6408) SNAP 2 PRIMARY SYSTEM TEST–OBJECTIVES, SYSTEM DESCRIPTION, AND PROCEDURES. G. M. Kikin (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 12, 1961. Contract [AT(11-1)-Gen-8]. 21p.

The SNAP-2 Primary System Test loop fabrication was completed with associated flight prototype components including reactor core and boiler mockups for volume and ΔP simulation, CRU-III NaK pump, compact heater, and expansion compensator. A mobile loading system was designed and fabricated with the capability of cleaning the NaK prior to final loop sealing. Loop descriptions, test objectives, and operating procedures are presented. (auth)

5085 (NAA-SR-Memo-6531) SNAP-2 SYSTEM HEAT BALANCE CODE. W. Botts (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 21, 1961. Contract [AT(11-1)-Gen-8]. 33p.

A computer code was developed for use in the evaluation of the design flow rates, heat balances, and various system temperatures in the Snap-2 system. The imputs to this code are the component design parameters such as efficiencies, fluid properties, power losses, and component leakage flow rates. (B.O.G.)

5086 (NP-11057) PROJECT SQUID SEMI-ANNUAL PROGRESS REPORT. Period covered: April 1, 1961 to September 30, 1961. A Cooperative Program of Fundamental Research as Related to Jet Propulsion. (Princeton Univ., N. J. James Forrestal Research Center). Oct. 1, 1961. Contract Nonr1858(25), NR-098-038. 115p.

Progress is reported on fluid mechanics, transport and transfer processes, chemical kinetics, and combustion phenomena. Topics covered include nonsteady and nonequilibrium flow, turbulence, partially-ionized gases in presence of electromagnetic fields, thermodynamic and transport properties of gases at high temperatures and pressures, statistical properties of two-phase flow, thermal conductivity of gases and liquids, fluid flow with suspended particles, elementary reactions in combustion, reaction kinetics in high-temperature gases, high temperature reactions, atom and free radical reactions, inelastic molecular collisions, solid-propellant flame mechanisms, initiation of spherical detonations by electric discharge, gaseous combustion, magnetohydrodynamics of partially ionized gases, fluctuations in plasma jets, flame structure and burning characteristics of propellants, and plasma flow in nozzles. (M.C.G.)

5087 (RAD-TR-61-28) INVESTIGATION OF RE-ENTRY DESTRUCTION OF NUCLEAR AUXILIARY POWERPLANT. (Avco Corp. Research and Advanced Development Div., Wilmington, Mass.). Oct. 1961. Contract AF33(616)-7530. 366p. (AFSWC-TR-61-69)

Work was undertaken to determine how the re-entry of a nuclear reactor from orbit can be made inherently harmless by the re-entry environment alone and without the use of fallible components. Accordingly, the problems involved in the re-entry destruction of a nuclear reactor–fuel-element exposure, meltdown of the fuel elements, dispersal of the molten residue, and combustion of the molten residue–were investigated by theoretical and experimental techniques. Results of this study indicate that without modification, flight models of the August 1960 developmental reactor-vehicle systems considered will not be reduced to a harmless residue by the re-entry environment. However, the parametric and design studies are relatively general, and they may be useful to designers in developing this and other reactor-vehicle systems for safe re-entry. This study recommends one method by which the reactor safety may be improved by design changes. The separate aspects of the re-entry sequence of destruction of the SNAP system and flight test recommendations are discussed. Detailed recommendations for a flight test program to prove the safety of a reactor designed for re-entry destruction are presented. (auth)

5088 (WADD-TR-61-96) PROPERTIES OF INORGANIC ENERGY-CONVERSION AND HEAT-TRANSFER FLUIDS FOR SPACE APPLICATIONS. Period covered: March 1960 to November 1961. W. D. Weatherford, Jr., John C. Tyler, and P. M. Ku (Southwest Research Inst., San Antonio). Nov. 1961. Contract AF33(616)-7206. 470p.

A properties handbook for various inorganic fluids which may have potential value as energy-conversion or heat-transfer fluids for space applications is presented. The fluids are given as three distinct classes: liquid metals, nonmetals, and gases. The liquid metals include mercury, cesium, rubidium, potassium, NaK (78), sodium, lithium, bismuth, and lead. The nonmetals include aluminum bromide, sulfur, and lithium hydride. The gases include argon, helium, and hydrogen. Data are presented, where available, up to temperatures ranging from 2300°F for mercury to 4500°F for lead, and for pressures ranging from less than one atmosphere to greater than twenty atmospheres. The enumerated properties include vapor pressure, density, viscosity, surface tension, electrical resistivity, thermal conductivity, specific heat, latent heats, enthalpyentropy relationships, melting point, critical properties, dielectric constant, ionization potential, magnetic susceptibility, thermal neutron cross sections, and corrosion characteristics. The characteristics of the various fluids are discussed, and the recommended values for the fluid properties are presented in either tabular or graphical form, or both, with detailed documentation as to basis and source. In addition, background material, including thermodynamic-cycle, heat-transfer, compatibility, and working fluid considerations is discussed. A summary of current research activities in this field is presented. (auth)

5089 ROCKET PROPULSION TECHNOLOGY. VOLUME 1. Proceedings of the First Rocket Propulsion Symposium, Cranfield, 1961. D. S. Carton, W. R. Maxwell, and D. Hurden. New York, Plenum Press, 1961. 381p. $12.50.

Seventeen papers are included on British work in the field of rocket propulsion with special emphasis put on the re-

liability and controllability of the propellants. Papers are presented on such topics as instrumentation techniques, pump efficiency measurement, solid propellant internal ballistics, hydrogen and packaged liquid propellants, and measurement of rate of burning and specific impulse. The topics on controllability are thrust-axis control, dual-thrust control of solid propellant rocket motors, control of the Spectre variable-thrust engine, control problems associated with the Black Knight high-altitude research vehicle and its propulsion system, and the control problems met in starting and stopping the engines. Topics on reliability are concerned with design and development of rocket engines, and charge inspection and metallurgical aspects of high-strength motor cases for solid-propellant motors. (N.W.R.)

5090 ADVANCED PROPULSION TECHNIQUES. Proceedings of a Technical Meeting, Pasadena, California, August 24-26, 1960. S. S. Penner, ed. New York, Pergamon Press, 1961. 261p. $10.00

Thirteen papers are included; separate abstracts have been prepared for nine. Three papers were previously abstracted in NSA. The topics are primarily concerned with space flight and are on the following subjects: power generation; nuclear, ion, and magneto fluid-dynamic propulsion; advanced propulsion in the NATO countries; summary of space propulsion; and some autobiographical comments on space law and astronautics within the next thirty years. (N.W.R.)

5091 SPACECRAFT POWER GENERATION. William C. Cooley (National Aeronautics and Space Administration, Washington, D. C.). p.3-22 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

The problem of generating electrical power in spacecraft outside the earth's atmosphere for mission durations of a few hours to several years is discussed. An estimate is made of the electrical power levels required in various spacecraft planned for development by the National Aeronautics and Space Administration, and then a discussion is presented of the research and development which is under way or which will be needed to provide adequate power from solar, chemical, or nuclear energy sources. (auth)

5092 NUCLEAR ROCKETS (PROJECT ROVER). R. E. Schreiber (Los Alamos Scientific Lab., N. Mex.). p.25-33 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

Project Rover has the objective of demonstrating the feasibility of nuclear rocket propulsion. Thrust is obtained by heating hydrogen in a heat-exchanger nuclear reactor and exhausting the hot gas through a nozzle. Hydrogen is chosen because of its low molecular weight. The nuclear rocket system offers approximately twice the specific impulse of the best chemical systems and gives a much higher payload capability for space missions normally requiring many chemical stages. The Kiwi-A test in 1959 is being followed by two reactor tests in 1960 and work is underway on more complete engine systems. (auth)

5093 NUCLEAR TURBOJETS. W. F. Savage (General Electric Co., Cincinnati). p.42-53 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

Both the direct and indirect nuclear turbojet propulsion systems are being considered for application to flight vehicles. Heat Transfer Reactor Experiments One, Two, and Three have shown the feasibility of operating turbojets on nuclear power using the direct air cycle concept. In these experiments, fuel element exit air temperatures of the order of 1600°F were obtained. In the selection of a nuclear turbojet configuration, performance, weight, ease, and flexibility of aircraft installation, reliability, and growth potential are major items of consideration. Minimum shield weight in an aircraft installation requires a portion of the shield to be located around both the crew and the reactor. Such an optimum division may not be possible due to radiation and activation problems associated with aircraft components. (auth)

5094 ION PROPULSION. Robert H. Boden (Rocketdyne, Canoga Park, Calif.). p.57-83 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

The purposes of this discussion are to define, in general terms, the ion propulsion systems which have been conceived to date, to present system considerations, to outline the construction of an ion rocket from energy source through thrust device, to consider resulting performance benefits, and to discuss ion generation including both surface-contact and arc-bombardment sources. (auth)

5095 ACCELERATION AND NEUTRALIZATION IN ELECTROSTATIC PROPULSION SYSTEMS. J. M. Sellen, Jr., Haywood Shelton, and David B. Langmuir (Ramo-Wooldridge, Canoga Park, Calif.). p.84-97 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

The principles and techniques of ion acceleration and focusing are well understood and, when combined with data on ion generation, permit some definite conclusions to be drawn about the general shape, dimensions, current densities, potentials, power consumption, and life of the over-all system. All these conclusions hinge on the assumption, however, that the device will operate as hoped, and this depends upon the achievement of a satisfactory charge neutralization system. The latter is less than satisfactorily understood. One reason undoubtedly is that ion beams employed heretofore have required perveances several orders of magnitude lower than are required for a thrust device, even of modest size. In presenting the basic features of these contrasting aspects of the electrostatic propulsion field, attempts are made to distinguish between matters which are essentially factual or firmly established, and others which still require clarification. (auth)

5096 ELECTRICAL PROPULSION WITH COLLOIDAL MATERIALS. Robert D. Schultz (Space Systems and Industrial Automation, Inc., Burbank, Calif.) and Raymond E. Wiech, Jr. p.98-115 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

The flexibility of utilizing charged, colloidal materials for ion propulsion is discussed. (auth)

5097 THE NATO COUNTRIES AND ADVANCED PROPULSION. p.179-85 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

The round-table discussion points out that with the exception of the United States, the NATO nations probably will not initiate any major programs on advanced propulsion for space flight. On the other hand, their interests may center on the fundamental scientific aspects of space and on the peaceful uses which may develop out of the knowledge derived from these scientific studies. (N.W.R.)

5098 SPACECRAFT PROPULSION. Addision M. Rothrock (National Aeronautics and Space Administration, Washington, D. C.). p.189-234 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

For flight outside the atmosphere of the earth, the chemical thermal rocket currently dominates the picture and will do so until the research on nuclear devices leads to practical engineering applications. The choice between

liquid or solid chemical propellants for space propulsion is currently being decided in favor of the former, except for smaller upper stages. Additional research is needed to determine the full potential of either system. As progress is made in adapting nuclear energy to spacecraft, the currently excessively difficult space missions will become practical. The choice between nuclear-thermal and nuclear-electric systems is uncertain at this time. Again, research is required. The research emphasis in flight propulsion from air-breathing to rocket engines has increased the required research areas many times. There is a great need for exploratory research that will permit us to focus our efforts. The expense and time involved makes co-ordination and organization of effort increasingly important. (auth)

5099 SPACE LAW AND A HISTORY OF ASTRONAUTICS—PREPARING FOR THE NEXT THIRTY YEARS. Andrew G. Haley (Haley, Wollenberg and Bader, Washington, D. C.). p.235-50 of "Advanced Propulsion Techniques." New York, Pergamon Press, 1961.

Autobiographical comments are made on the legal aspects of space flight and of the history of astronautics. Very little is mentioned of the strict legal character of space flight since lawyers and politicians have completely failed up to this time in recognizing the legal problems and in implementing solutions. The discussion is mainly concerned with the course of astronautics over the next thirty years and these comments come from the prognostications of the author. (N.W.R.)

WASTE DISPOSAL AND PROCESSING

5100 (HW-71374) RESEARCH AND DEVELOPMENT ACTIVITIES FIXATION OF RADIOACTIVE RESIDUES QUARTERLY PROGRESS REPORT, JULY–SEPTEMBER 1961. E. R. Irish, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 13, 1961. Contract AT(45-1)-1350. 43p.

Progress is reported on research and development work in pot calcination and radiant-heat spray calcination studies of synthetic Purex high-level wastes; and sorption studies using synthetic minerals and resins as well as natural minerals. The calcination studies are discussed in terms of batch calcination, melting of pot calcination products, spray calcination, and off-gas treatment; and sorption studies in terms of mineral reactions, fixation chemistry, and condensate wastes. (B.O.G.)

5101 (AEC-tr-4900) CONDITIONING OF RADIOACTIVE WASTE WITH BITUMEN. J. Rodier, J. Scheidhauer, and M. Malabre (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucleaires, Saclay). Translated by Martha Gerrard (Oak Ridge National Lab., Tenn.) from report CEA-1992. 1961. 13p.

This paper was previously abstracted from the original language and appears in NSA, Vol. 16, abstract No. 1279.

5102 PURIFICATION OF RADIOACTIVE WASTE SOLUTIONS WITH NATURAL INORGANIC ION EXCHANGERS. I. THE APPLICATION OF SILICATE CLAYS AS ION EXCHANGERS. G. Sachse (Zentralinstitut für Kernphysik, Rossendorf, Ger.) and E. Leibnitz. Kernenergie, 4: 633-6(Aug. 1961). (In German)

After establishment of the advantages which are obtained in the utilization of inorganic exchangers to processing of radioactive waste solutions, it is shown which silicate clay minerals are suitable for this purpose. The clay material used for the investigations was approximately characterized by Debye-Scherrer diagrams, electron optical formations, differential thermal analysis, and elementary analysis. A brief survey on the stabilization of clays with polyelectrolytes, which is necessary for their use in columns as exchange materials, is given in conclusion. (tr-auth)

5103 DO RADIOACTIVE MATERIALS AFFECT SLUDGE DIGESTION? PART 1. RADIOACTIVITY AND DIGESTION—NEW PROBLEM OF THE ATOMIC ERA. PART 2. Werner N. Grune, Chun-Fei Chueh, and Roy Peek. Wastes Eng., 32: 18-23; 82-7; 96 (Jan.-Feb. 1961).

Studies on the effects of carrier-free I^{131} and P^{32} on the anaerobic digestion of waste sludge are discussed. The problem of radioactive waste disposal deals with those wastes from the atomic energy industry which are high in volume but of low-level activity. Carrier-free concentrations of I^{131} from 1 to 600 mc/l and P^{32} from 1 to 800 mc/l were investigated in an effort to establish what would constitute the tolerance level during anaerobic digestion of sludge. Due to the long half life of some radioactive materials, it is necessary to evaluate the ultimate fate of these wastes before any significant quantities can be released into the air, soil, or stream. Objectives of the investigation are included. The procedures and methods carrying out the studies with carrier-free I^{131} and a discussion of the results are presented. Analytical data are summarized, and the results based on information from 72 digesters during 5 runs of carrier-free I^{131} with concentrations up to 100 mc/l are given. The studies of critical concentrations of carrier-free P^{32} which affect anaerobic digestion are also discussed. (Public Health Eng. Abstr., 41: No. 11, 1961).

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Because of problems involving the mechanical preparation of this index, all accent marks are omitted. The following changes in spelling have been introduced to reduce some of the confusion which might result from omitting the accents:

Æ	becomes	ae
Ö		oe
ø		oe
Ü		ue (except in transliterated Chinese names)

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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number in that volume. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. Published literature (journal article or book) is identifiable by the absence of a report number.

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126	16-4490	See AECL-1265(Paper 5)
CEND–	**(Misc.)**	
104	16-4676	Dep.; $2.00(OTS)
136	16-4238	Dep.(mc); $9.10(fs), $3.35(mf) OTS
CERN–	**(Non-AEC)**	
61-23	16-4884	Dep.(mc)
61-26	16-4239	Dep.(mc)
61-27	16-4685	Dep.(mc)
61-28	16-4686	Dep.(mc)
61-29	16-4317	Dep.(mc)
CF–	**(Oak Ridge National Laboratory)**	
52-5-117	16-4216	Dep.(mc); $1.60(fs), $0.80(mf) OTS
61-5-54(Rev.)	16-4433	Dep.(mc); $1.10(fs), $0.80(mf) OTS
CLOR–	**(Polish)**	
8	16-4391	Dep.(mc)
CNEN–	**(Italian)**	
64	16-4434	Dep.(mc)
65	16-4435	Dep.(mc)
88	16-4436	Dep.(mc)
94	16-4318	Dep.(mc)
CNI–	**(Italian)**	
93	16-4132	Dep.(mc)
95	16-4392	Dep.(mc)
96	16-4437	Dep.(mc)
98	16-4578	Nuovo cimento (10), 19: 393-5(1961)
CRRP–	**(Canadian)**	
985-B	16-4677	Dep.; $2.00(AECL)
CTSL–		
30	16-4885	Dep.(mc); $5.60(fs), $1.73(mf) OTS
CVNA–	**(Misc.)**	
100	16-5013	Dep.(mc); $14.00(fs), $6.44(mf) OTS
D–	**(Misc.)**	
1-82-0007*	16-4894	
1-82-0024*	16-4895	
1-82-0032*	16-4896	
1-82-0051*	16-4438	
1-82-0063*	16-4687	
1-82-0077*	16-4897	
1-82-0079*	16-4439	
1-82-0103*	16-4526	
1-82-0105*	16-4440	
1-82-0108*	16-4898	
1-82-0111*	16-4899	
1-82-0114*	16-4900	
1-82-0115*	16-4688	
1-82-0116*	16-4665	
1-82-0117*	16-4666	
1-82-0118*	16-4901	
1-82-0121*	16-4902	
1-82-0125*	16-4903	
DEG-Inf. Ser.	**(British)**	
87	16-4453	Dep.
DESY-A–	**(German)**	
2.78	16-4886	Dep.(mc)
DL–	**(Non-AEC)**	
45	16-4962	Dep.; $1.00(AECL)
DMIC–	**(Non-AEC)**	
160	16-4527	
DMIC-Memo–	**(Non-AEC)**	
134	16-4528	
136	16-4509	
138	16-4529	OTS
140	16-4510	
DOFL-TR–	**(Non-AEC)**	
777	16-3983	$1.00(OTS) as PB-171026
DP–		
581	16-4585	Dep.; $2.00(OTS)
624	16-4217	Dep.; $0.75(OTS)
628	16-5014	Dep.; $0.50(OTS)
640	16-4678	Dep.; $0.75(OTS)
675	16-5015	Dep.; $0.75(OTS)
DPC-PCA–	**(French)**	
61-14	16-4493	See NP-10978
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EURAEC–		
1	16-5016	Free; DTI Extension
EXP-NRX–	**(Canadian)**	
6304	16-4963	Dep.; $1.00(AECL)
F-A–	**(Misc.)**	
2150	16-4246	See NYO-2856
FTD-TT–	**(Non-AEC)**	
61-30	16-3990	OTS
61-51	16-4278	OTS
61-58	16-4554	OTS
61-60	16-4756	OTS
61-74	16-4555	OTS
61-75	16-4164	OTS
61-104	16-4623	OTS
61-115	16-4697	OTS
61-153	16-4279	OTS
GA–	**(Misc.)**	
1612(Vol.I)	16-5017	Dep.; $2.75(OTS)
2235	16-4511	Dep.; $2.75(OTS)
2528(Vol.I)*	16-4153	
2528(Vol.II)*	16-4154	
2528(Vol.III)*	16-4155	
2563	16-4749	Dep.(mc); $2.60(fs), $0.98(mf) OTS
2670*	16-5078	
GAMD–	**(Misc.)**	
1124(Rev.)	16-4240	Dep.(mc); $7.60(fs), $2.36(mf) OTS
1179	16-4964	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1250	16-4965	Dep.(mc); $1.60(fs), $0.80(mf) OTS
1572	16-5018	Dep.(mc); $4.60(fs), $1.67(mf) OTS
1581	16-4441	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2154	16-5019	Dep.(mc); $1.60(fs), $0.80(mf) OTS
GAT-T–		
552(Rev.1)	16-4156	Dep.(mc); $1.10(fs), $0.80(mf) OTS
GEMP–		
6A	16-4586	Dep.; $0.50(OTS)
GNEC–		
168	16-5020	Dep.; $1.75(OTS)
176(Del.)	16-5021	Dep.; $2.25(OTS)
202	16-5022	Dep.(mc); $10.10(fs), $4.01(mf) OTS
HMI-B–	**(German)**	
14	16-4442	Dep.(mc)
HPR–	**(Norwegian)**	
11	16-5023	Dep.(mc)
HT–	**(Non-AEC)**	
10	16-4946	See AFOSR-1138
HW–		
51938	16-3994	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63791(Rev.1)	16-4218	Dep.(mc); $1.10(fs), $0.80(mf) OTS
65722(Rev.)	16-4241	Dep.; $1.25(OTS)
66309	16-4393	Dep.(mc); $1.10(fs), $0.80(mf) OTS
68609	16-5068	Dep.(mc); $1.60(fs), $0.80(mf) OTS
68630	16-4219	Dep.; $0.75(OTS)
69681	16-4492	Dep.; $0.50(OTS)
70315	16-4966	Dep.; $0.50(OTS)
70944	16-4679	$1.60(fs), $0.80(mf) OTS
71203	16-4394	Dep.; $0.75(OTS)
71374	16-5100	Dep.; $1.00(OTS)
HW-SA–		
1775	16-4489	p.764-78 of "Plutonium 1960," Clever-Hume Press Ltd., London, £9 9s
2012	16-4967	Dep.(mc); $1.60(fs), $0.80(mf) OTS
IA–	**(Israeli)**	
565	16-4368	
607	16-4133	Dep.(mc)
642	16-4750	Dep.(mc)

Report No.	Abstract No.	Availability
692	16-4134	Dep.(mc)
IC–	**(Canadian)**	
128	16-4535	See NP-11092
130	16-4536	See NP-11093
IDO–		
12019	16-4395	Dep.(mc); $11.00(fs), $4.67(mf) OTS
14563	16-4220	Dep.; $0.50(OTS)
14565	16-4221	Dep.; $0.50(OTS)
14566	16-4222	Dep.; $0.50(OTS)
16607(Add.)	16-4968	Dep.(mc); $7.60(fs), $2.48(mf) OTS
16709	16-4969	Dep.(mc); $2.60(fs), $0.95(mf) OTS
16729	16-4587	Dep.; $0.50(OTS)
INE-M–	**(Australian)**	
4	16-4402	See NP-11142
IS–		
92	16-4172	J. Inorg. & Nuclear Chem. 18: 98-102 (1961)
164	16-4582	p.881-4 of "Proceedings of the International Conference on Semiconductor Physics, Prague, 1960"
270	16-4129	p.579-89 of "Advances in the Chemistry of the Coordination Compounds," New York, The Macmillan Co., 1961
317	16-4128	p.227-9 of "Advances in the Chemistry of the Coordination Compounds," New York, The Macmillan Co., 1961
329	16-4223	Dep.; $1.25(OTS)
JAERI–	**(Japanese)**	
4019	16-4751	
JINR–	**(Russian)**	
P-765	16-4689	Dep.(mc)
JPL-TR–	**(Non-AEC)**	
32-190	16-5079	
JPRS–	**(Non-AEC)**	
10581	16-4329	OTS
10595	16-4409	OTS
10645	16-4113	OTS
10815	16-4990	OTS
10843	16-4034	OTS
10882	16-4114	OTS
10883	16-4010	OTS
10884	16-4011	OTS
10888	16-4376	$0.50(OTS)
10914	16-4035	OTS
10917	16-4012	OTS
10918	16-4115	OTS
10920	16-4330	OTS
10980	16-4410	$1.50(OTS)
11013	16-4116	OTS
11075	16-4255	OTS
11077	16-4013	OTS
11109	16-4036	OTS
11168	16-4037	OTS
11213(Pts.I&II)	16-4428	OTS
11221	16-4014	OTS
11256	16-4229	OTS
11292	16-4211	OTS
11419	16-4016	OTS
KAPL–		
2173	16-4242	Dep.; $0.50(OTS)
KFK–	**(German)**	
62	16-4186	Dep.(mc)
KR–	**(Norwegian)**	
11	16-4224	Dep.(mc)
LA–		
2591	16-4512	Dep.; $1.25(OTS)
2626	16-4157	Dep.; $0.50(OTS)
2638	16-4319	Dep.; $4.60(fs), $1.43(mf) OTS
LAMS–		
2532(Vol.II)	16-3984	Dep.; $2.00(OTS)
2543	16-4680	Dep.; $1.75(OTS)

Report No.	Abstract No.	Availability
LMSC–	**(Misc.)**	
6-90-61-75*	16-4540	See NP-11154
LTRS-RM–	**(British)**	
365	16-3993	See AERE-R-3811
MGCR-RE–		
269	16-5018	See GAMD-1572
MND–	**(Misc.)**	
2584	16-4422	Dep.(mc); $6.60(fs), $2.18(mf) OTS
MND-MD–		
2539	16-5024	Dep.; $2.50(OTS)
2540	16-4970	Dep.(mc); $8.10(fs), $2.66(mf) OTS
2541	16-5025	Dep.(mc); $8.60(fs), $3.08(mf) OTS
2560-2	16-5026	Dep.(mc); $10.10(fs), $3.83(mf) OTS
MND-P–		
2581-III(Pt.I)	16-5080	Dep.(mc); $3.50(OTS)
2581-III(Pt.II)	16-5081	Dep.(mc); $4.50(OTS)
3015-I	16-5082	Dep.(mc); $4.60(fs), $1.43(mf) OTS
MND-SR–		
2615	16-5083	Dep.; $3.00(OTS)
NAA-SR–		
3829(Suppl.1)	16-4971	Dep.; $1.25(OTS)
5049	16-4972	Dep.; $0.50(OTS)
6048	16-4491	See AECL-1265(Paper 9)
6125	16-4530	Dep.; $0.50(OTS)
6291	16-4531	Dep.; $0.75(OTS)
6357	16-4973	Dep.; $0.50(OTS)
6359	16-4974	Dep.; $2.25(OTS)
6386	16-4451	Dep.; $0.50(OTS)
6454	16-4513	Dep.; $0.50(OTS)
6617	16-4532	Dep.; $0.50(OTS)
6681	16-4272	Dep.; $1.50(OTS)
NAA-SR-Memo–		
865(Rev.)	16-4975	Dep.(mc); $1.10(fs), $0.80(mf) OTS
1035	16-4225	Dep.(mc); $6.60(fs), $2.12(mf) OTS
3756	16-5070	Dep.(mc); $1.60(fs), $0.80(mf) OTS
3757	16-5071	Dep.(mc); $1.10(fs), $0.80(mf) OTS
4094	16-5027	Dep.(mc); $4.60(fs), $1.46(mf) OTS
4789	16-4320	Dep.(mc); $1.60(fs), $0.80(mf) OTS
4823	16-5028	Dep.(mc); $2.60(fs), $0.95(mf) OTS
4996	16-5029	Dep.(mc); $2.60(fs), $0.95(mf) OTS
5184(Rev.B)	16-4243	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5238	16-4396	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5265	16-4976	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6408	16-5084	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6531	16-5085	Dep.(mc); $3.60(fs), $1.19(mf) OTS
6569	16-4244	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6583	16-4245	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6587	16-4681	Dep.(mc); $2.60(fs), $0.83(mf) OTS
6626	16-5030	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6630	16-4321	Dep.(mc); $1.60(fs), $0.80(mf) OTS
6631	16-5031	Dep.(mc); $2.60(fs), $1.01(mf) OTS
6640	16-4977	Dep.(mc); $1.60(fs), $0.80(mf) OTS
NADC-MA–	**(Non-AEC)**	
L6035	16-4397	
NAS-NS–	**(Misc.)**	
3104	16-4226	Dep.; $1.25(OTS)
NBS–	**(Misc.)**	
7207	16-4904	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NBS-TN–	**(Non-AEC)**	
91	16-4607	$0.50(OTS) as PB-161592
92	16-4608	$1.50(OTS) as PB-161593
NDA–	**(Misc.)**	
2119-1	16-4533	Dep.; $0.75(OTS)
NDL-TR–	**(Non-AEC)**	
8	16-5072	
NLCO–		
800	16-4208	Dep.(mc); $9.60(fs), $3.62(mf) OTS
NMI-ABB–		
1	16-4514	Dep.(mc); $9.60(fs), $3.80(mf) OTS
NP–	**(AEC File No. for Non-AEC Reports)**	
10713	16-4398	

Report No.	Abstract No.	Availability
10731	16-4978	Dep.(mc)
10738	16-4399	Dep.; $0.50(OTS)
10773	16-4690	Dep.(mc)
10802	16-4588	
10943	16-4609	
10978	16-4493	
10989	16-4443	
11020	16-3995	
11054	16-4515	
11056	16-4494	Dep.(mc)
11057	16-5086	
11058	16-4610	
11085	16-4209	Dep.(mc)
11088	16-4534	
11090	16-4322	Dep.(mc)
11092	16-4535	$0.25; as Can. Dept. Mines Tech. Surveys, Mines Branch Inform. Cir. IC-128
11093	16-4536	$0.25; as Can. Dept. Mines Tech. Surveys, Mines Branch Inform. Cir. IC-130
11098	16-4611	
11113	16-4005	
11115	16-4006	
11116	16-4400	
11120	16-4323	
11126	16-4516	
11127	16-4537	
11128	16-4517	
11129	16-4943	
11135	16-4324	OTS
11140	16-4401	
11142	16-4402	Dep.(mc)
11143	16-4619	
11144	16-4452	
11146	16-4589	
11147	16-4538	
11148	16-3985	Dep.(mc)
11151	16-4539	Dep.(mc)
11152	16-4887	
11153(Vols.I&II)	16-4403	Dep.(mc); $22.25(fs), $9.97(mf) OTS
11154	16-4540	OTS
11159	16-4541	
11160	16-4542	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
816	16-3991	OTS
822	16-4165	OTS
823(Pts.I&II)	16-4454	OTS
824	16-4039	$1.60(fs), $0.80(mf) JCL
825	16-4022	Dep.(mc)
827	16-4280	OTS
828	16-4556	Dep.(mc); $3.60(fs), $1.28(mf) JCL
830	16-4331	Dep.(mc); $1.10(fs), $0.80(mf) JCL
831	16-4332	Dep.(mc); $2.60(fs), $1.01(mf) JCL
NRC–	**(Canadian)**	
6577	16-4631	Can. J. Phys. 39: 1888-1900(1961)
NRL–	**(Misc.)**	
5675*	16-4273	
5692*	16-4369	
5697*	16-4752	
5704*	16-4543	
NSEC–		
47	16-5032	Dep.; $2.50(OTS)
NUMEC-P–		
80	16-4985	Dep.(mc); $5.60(fs), $1.85(mf) OTS
NYO–		
2687	16-4986	Dep.(mc); $2.60(fs), $1.04(mf) OTS
2856	16-4246	Dep.; $2.75(OTS)
9848	16-4423	Dep.(mc); $1.60(fs), $0.80(mf) OTS
ONR–	**(Non-AEC)**	
9(Vol.3)	16-4370	
ORNL–		
3126	16-4325	Dep.; $1.50(OTS)
3165	16-4247	Dep.; $1.25(OTS)
3175	16-4248	Dep.; $1.75(OTS)
3185	16-4187	Dep.; $0.50(OTS)
3187	16-4249	Dep.; $0.50(OTS)
3207	16-4753	Dep.; $4.50(OTS)
3230	16-4499	Dep.; $1.25(OTS)
3235	16-4444	Dep.; $0.50(OTS)
3236	16-4158	Dep.; $0.50(OTS)
ORNL-TM–		
8	16-4250	Dep.(mc); $3.60(fs), $1.19(mf) OTS
26	16-4987	Dep.(mc); $8.60(fs), $3.17(mf) OTS
33	16-4227	Dep.(mc); $5.60(fs), $1.88(mf) OTS
42	16-4988	Dep.(mc); $6.60(fs), $2.09(mf) OTS
51	16-4500	Dep.(mc); $2.60(fs), $0.98(mf) OTS
64	16-4135	Dep.(mc); $1.10(fs), $0.80(mf) OTS
66	16-4989	Dep.(mc); $8.10(fs), $2.63(mf) OTS
73	16-4740	Dep.(mc); $1.10(fs), $0.80(mf) OTS
77	16-4326	Dep.(mc); $2.60(fs), $0.95(mf) OTS
ORO-SP–	**(Non-AEC)**	
174	16-4007	
OTS–	**(Non-AEC)**	
61-21970	16-4426	$0.50(OTS)
P-A–	**(Non-AEC)**	
2476-6	16-4541	See NP-11159
PAN–	**(Polish)**	
241/VI	16-4251	Dep.
242/1-B	16-4327	Dep.(mc)
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
884,272	16-4265	
884,282	16-4360	
884,298	16-5005	
884,317	16-4361	
884,349	16-4362	
884,424	16-4449	
884,498	16-5006	
884,577	16-4522	
884,607	16-5007	
884,611	16-4233	
884,666	16-4213	
884,682	16-4583	
884,702	16-4234	
884,705	16-4937	
884,719	16-4938	
884,731	16-4206	
884,732	16-4207	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,015,618	16-4939	
3,015,748	16-4940	
3,016,341	16-4941	
3,016,342	16-4942	
3,016,458	16-4891	
3,016,459	16-4266	
3,016,475	16-4267	
3,017,242	16-4235	
3,017,286	16-4523	
3,018,159	16-4236	
3,018,169	16-4524	
3,018,238	16-5008	
3,018,239	16-5009	
3,018,240	16-5010	
3,018,253	16-4183	
3,018,386	16-4363	
3,018,460	16-4268	
3,018,980	16-4269	
PB–	**(Non-AEC)**	
161592	16-4607	See NBS-TN-91
161593	16-4608	See NBS-TN-92
171026	16-3983	See DOFL-TR-777
PG-Report–	**(British)**	
58(2nd Ed.)	16-4136	Dep.; $0.25(BIS)
263	16-4137	Dep.; $0.35(BIS)

Report No.	Abstract No.	Availability
280	16-4138	Dep.
PIBMRI–	**(Non-AEC)**	
931-61	16-4888	
PPAD–		
411-D	16-4889	See TID-13433
PR-P–	**(Canadian)**	
50	16-4620	Dep.; $2.00(AECL)
PRDC-TR–		
50	16-5033	Dep.(mc); $1.60(fs), $0.80(mf) OTS
PUC–		
1961-45	16-4754	Dep.(mc); $9.10(fs), $3.26(mf) OTS
RAD-TR–	**(Non-AEC)**	
61-28	16-5087	
RADC-TN–	**(Non-AEC)**	
61-87	16-4667	
REIC–	**(Non-AEC)**	
21	16-4590	
RME–		
4535(Rev.)	16-4373	Dep.; $0.50(OTS)
RMO–		
4015	16-4210	Dep.; $3.50(OTS)
RR–	**(Misc.)**	
60-91*	16-4515	See NP-11054
S–	**(Misc.)**	
190*	16-4516	See NP-11126
191*	16-4537	See NP-11127
192*	16-4517	See NP-11128
SAER–	**(French)**	
1409/930	16-4432	See CEA-2007
SB–	**(Non-AEC)**	
61-52	16-4324	See NP-11135
SCL-T–		
381	16-4910	Dep.(mc); $2.60(fs), $0.86(mf) JCL
389	16-4624	Dep.(mc); $1.60(fs), $0.80(mf) JCL
390	16-4364	Dep.(mc); $1.10(fs), $0.80(mf) JCL
391	16-4557	Dep.(mc); $1.60(fs), $0.80(mf) JCL
SCTM–		
232-61-81	16-3986	Dep.; $0.50(OTS)
SI-Pub.–	**(Norwegian)**	
290	16-4494	See NP-11056
SM–	**(Misc.)**	
36000*	16-4400	See NP-11116
STI-PUB–	**(International Atomic Energy Agency)**	
15/16	16-5038	$1.00(IAEA)
30(Vol.II)	16-5039	$7.00(IAEA)
TG–	**(Misc.)**	
230-T256*	16-4365	
TID–		
3560	16-4544	Dep.; $3.00(OTS)
8537	16-4424	Dep.; $2.50(OTS)
12946(App.I, Vol.I)	16-4029	Dep.(mc); $9.10(fs), $3.26(mf) OTS
12946(App.I, Vol.II)	16-4030	Dep.(mc); $8.60(fs), $2.96(mf) OTS
12946(App.II)	16-4031	Dep.(mc); $5.60(fs), $1.88(mf) OTS
13093	16-4374	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13228	16-4008	Dep.; $1.25(OTS)
13433	16-4889	Dep.(mc); $6.60(fs), $2.06(mf) OTS
13434	16-4905	Dep.(mc); $1.10(fs), $0.80(mf) OTS
13492	16-4755	Dep.(mc); $12.00(fs), $5.09(mf) OTS
13688	16-4501	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13691	16-4502	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13768	16-4691	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13911	16-4110	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13955	16-4692	Dep.(mc); $4.60(fs), $1.55(mf) OTS
13959	16-4032	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13960	16-4693	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14000	16-4139	Dep.(mc); $2.60(fs), $1.01(mf) OTS
14004	16-4274	Dep.; $2.50(OTS)
14085	16-4188	Dep.(mc); $3.60(fs), $1.34(mf) OTS
14136	16-4947	Dep.(mc); $3.60(fs), $1.13(mf) OTS
14137	16-4694	Dep.(mc); $2.60(fs), $0.83(mf) OTS
14157	16-4741	Dep.(mc); $4.60(fs), $1.43(mf) OTS
14242	16-4503	Dep.(mc); $2.60(fs), $0.92(mf) OTS
14266	16-4668	Dep.(mc); $1.60(fs), $0.80(mf) OTS
14284	16-4111	Dep.(mc); $1.10(fs), $0.80(mf) OTS
14357	16-4948	Dep.(mc); $3.60(fs), $1.31(mf) OTS
14358	16-4545	$4.60(fs), $1.58(mf) OTS
14359	16-4546	$4.60(fs), $1.55(mf) OTS
14360	16-4944	Dep.(mc); $13.00(fs), $5.84(mf) OTS
14425	16-4375	Dep.(mc); $6.60(fs), $2.15(mf) OTS
TRG-Report–	**(British)**	
25	16-4404	Dep.; $0.42(BIS)
UCLA–		
455	16-4405	Dep.(mc); $1.60(fs), $0.80(mf) OTS
UCRL–		
5827	16-4906	Dep.; $0.75(OTS)
6219	16-4519	Ind. Eng. Chem. 53: 737-8(1961)
6353	16-4636	J. Appl. Phys. 32: 1789-90(1961)
6446	16-4847	Nuclear Phys. 27: 665-72(1961)
6526	16-4945	Dep.; $3.50(OTS)
6529	16-4252	Dep.; $0.50(OTS)
6576	16-4253	Dep.; $0.50(OTS)
6581	16-4445	Dep.(mc); $4.60(fs), $1.70(mf) OTS
6654	16-4406	Dep.; $1.00(OTS)
8030(Rev.)	16-4695	Dep.; $0.75(OTS)
9438(Rev.)	16-4838	Nuclear Phys. 27: 529-53(1961)
9609	16-4839	Nuclear Phys. 27: 554-60(1961)
9657	16-4407	Dep.; $0.50(OTS)
9663	16-4890	Dep.; $0.50(OTS)
9744	16-4275	Dep.; $3.00(OTS)
9777	16-4907	Dep.; $2.75(OTS)
9835	16-4696	Dep.; $2.25(OTS)
9903	16-4189	Dep.; $0.50(OTS)
9922	16-4949	Dep.; $2.25(OTS)
UCRL-Trans–		
731(L)	16-4625	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
742	16-4911	Dep.(mc); $1.60(fs), $0.80(mf) JCL or OTS
749(L)	16-4626	Dep.(mc); $5.60(fs), $1.91(mf) JCL
751(L)	16-4912	Dep.(mc); $1.10(fs), $0.80(mf) JCL
755(L)	16-4258	Dep.(mc); $1.60(fs), $0.80(mf) JCL
UCSF–		
21	16-4009	Dep.; $2.25(OTS)
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2064	16-4591	
USCEC–	**(Non-AEC)**	
79-203	16-4908	OTS
83-209	16-4909	
USNRDL-TR–	**(Non-AEC)**	
532	16-4033	
535	16-4228	
VDIT–	**(Swedish)**	
7.1	16-4504	Dep.(mc)
37	16-4276	Dep.(mc)
WADC-TR–	**(Misc.)**	
59-595(Pt.II)*	16-4547	OTS
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WADD-TN–	**(Non-AEC)**	
61-1	16-4254	
WADD-TR–	**(Non-AEC)**	
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60-418(Pt.II)	16-4518	OTS
60-893	16-4550	OTS
60-904	16-4551	OTS
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1327	16-4447	Commun. ACM (Assoc. Computing Machinery) 4: 354-5(1961)
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